THE ASTRONOMICAL REGISTER.

THE

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FOR AMATEUR OBSERVERS, AND ALL OTHERS INTERESTED IN THE
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BY G. J. WALKER, ESQ.

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The Astronomical Register.

No. 97. JANUARY. 1871.

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ADDRESS.

THE pressure upon our limited space, from more interesting matter, prevents us from saying much to our kind friends and subscribers; but we cannot pass over the commencement of our Ninth volume without a few words to them.

It has not been without much trouble and anxiety that the *Astronomical Register* has been carried through eight volumes. In fact, had it not been for the determination of its projector to continue the publication of this Journal, while so many other scientific periodicals collapsed, notwithstanding a certain amount of pecuniary loss; the *Register* must have been given up in its first lustrum; for—to take our readers for once so far into our confidence—there was a decided loss upon the first five volumes. We are happy to say that for the last three years the number of our subscribers has slowly but steadily increased, so that now there is a slight profit upon our publication. Even now, however, the original loss of the earlier years is not entirely covered. It is this increase that has enabled us to continue our friendly and pleasant intercourse with our readers.

If our circulation could be considerably enlarged, we should be able to carry out many excellent suggestions which have been frequently made. If we could see our way to do so, we should much like to increase the number of our pages—to give more illustrations, often so necessary to a full understanding of the subjects treated upon.

We take this opportunity of thanking several kind friends for their valuable advice, and to assure them that we have not forgotten them. As far as opportunities allow, we shall from time to time carry them into effect. We are glad to say that we still receive, in numerous letters from our correspondents at home and abroad, the most gratifying testimony as to the efficiency and usefulness of the *Register;* and we have every confidence that, with the help of our friends, we shall be enabled to carry it on with renewed vigour and still greater usefulness.

THE ECLIPSE EXPEDITION.

The arrangements having been completed, and the organization effected as well as the short time at the disposal of the Committee allowed, the Spanish party of the observers left Portsmouth in H.M.S. *Urgent*, on the morning of Tuesday, December 6th. The vessel carried out Professor Newcombe, U.S., and Mrs. Newcombe.

The *Cadiz detachment* comprised the Rev. E. J. Perry, in charge of the party, who would himself observe with the Spectroscope; Mr. Mackay, his assistant; Messrs. Moulton, Hudson, and Fizon, for the Polariscope observations; Messrs. Nassel, Smyth, Penrose, and Collins, to sketch the Corona; and Captain Toynbee, to manage the time and general observations.

The *Gibraltar troop*, under the care of Capt. Parsons, R.E. and Lieut. Brown, R.A., included: for the Spectroscope, Messrs. Carpmael and Girdon; for the Polariscope, Messrs. Lewis, Ladd, and Baynes; for the Photography, Mr. Buckingham and assistant; for sketching the Corona, Messrs. Hunter, Harrison, and Anson; and for observing Saturn in the Corona, Messrs. Talmage, Maclear, and Thorpe.

The *Urgent* also carries so far as Gibraltar the party who will there be turned over to a smaller vessel, and conveyed to Oran. This section includes the following very able observers, viz.: Dr. Huggins, Professor Tyndal, the Rev. F. Howlett, Mr. Carpenter (of Greenwich Observatory), Mr. Crookes, Capt. Noble, Admiral Ommaney, and Dr. J. H. Gladstone.

Lord Lindsay and his assistants started some time before the

Expedition, fully equipped for photographing the Eclipse near Cadiz.

The *Sicily department* of the Expedition has necessarily had to proceed overland, on account of the short time at its disposal.

The party left Charing Cross station on the night of Wednesday, December 7th; and we learn from *Nature* that they arrived at Rome safely on the morning of the 12th. The party intended leaving Naples for Syracuse in H.M.S. *Psyche*, in the course of the 14th Dec. The observers are Mr. and Mrs. Lockyer, Professor Roscoe and his assistant, Mr. Bowen, Mr. Seabrooke, Mr. Pedler and Mr. Barton, for the Spectroscope; Mr. Ranyard, Mr. Griffiths, Mr. Clifford, Mr. Adams and Mr. Harris, for the Polariscope; Messrs. Brett and Darwin, for Sketching; Mr. Brothers, Herr Vozel and Mr. Fryer, for Photography; Mr. Vignolles and Mr. Vignolles, jun., for time and general observations; and Professor Thorpe, for Chemical Intensity. Some of the American Expedition also observe in Sicily.

The *Psyche* started from Naples as proposed, but, unfortunately, on her way to her destination, she struck on a rock off Catania. The passengers and philosophical instruments were all saved; and so, we trust, the Expedition will still accomplish the object proposed.

The list of the University of Oxford appointed to the English Eclipse Expedition is—for the Polariscope: Messrs. G. B. Lewis, of Oriel; R. Abbay, of Wadham; F. W. Fizon, of Christchurch; E. Baynes, of Wadham:—Sketching the Corona, Messrs. F. H. Browne, of Wadham; E. G. Harrison, of Merton; F. H. Anson, of Baliol.

At the time of writing this, nothing more is known of the movements of the Expedition; and we can only wish all parties the success they deserve, and express a hope that Science may be a gainer by their labours, and that the vexed question of the nature of the Corona will be settled on this occasion.

THE ECLIPSE OF THE SUN, DECEMBER 22.

The heavy snow-clouds shrouding the sky seemed, during the earlier hours of the morning, to preclude the possibility of getting even a glimpse of the sun. All hope of observing any of the phenomena appeared quite hopeless as the time of the Eclipse drew on, at any rate in our neighbourhood; but, a little before noon, breaks in the clouds gave a passing view of the sun, enabling even those who were not prepared with dark glasses to have a fair sight of the Eclipse. After noon the sky cleared round and

behind the sun, so that the end of the Eclipse was perfectly seen. The beautiful blue of the sky, at the period of greatest obscuration, was very striking. Upon the sun's disk there were several small spots, and one magnificent double spot connected by numerous smaller ones. The emersion of this fine object from the dark body of the moon was a beautiful sight. A bridge of exceedingly bright light across the larger spot was very noticeable. This spot occupied 13½ seconds in completely passing a wire in the telescope. The instrument used was a portable one by Thos. Cooke, of 2¾-in. aperture. The continual passage of clouds prevented the use of eye-pieces of high power, and so nothing particular was noticed upon the edge of the moon.

We have received the following from Mr. J. Gilby, of Beverley:—

The sun was visible from the commencement of the Eclipse until 5 minutes past 12 o'clock, when it became obscured and remained so till 20 minutes before 1, thus preventing me from seeing the greatest obscuration.

I have nothing to note except a curious spot, or rather two with a connecting line between them, on the NW. side of the sun. They seemed to undergo some little alteration during the Eclipse.

The following, from Lord Lindsay's Expedition, appears in the *Standard*:—

Puerto, Dec. 22, 1.5 p.m.

Photographs successful; two good pictures of corona. Polariscope doubtful. Sketching good. Spectrum no lines; broken sky.

The rest of the telegram is unintelligible.

I am your obedient servant,

41, Parliament Street, Dec. 24. J. S. BERGHEIM.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Second Meeting, December 9, 1870.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries (*pro tem.*)—T. W. Burr, Esq., and E. Dunkin, Esq.

The Minutes of the last meeting were read and confirmed.

Thirty-five presents were announced, including the 4th volume of the Catalogue of Scientific Papers compiled by the Royal Society, and the thanks of the meeting given to the respective donors.

H. Barnes, Esq., was balloted for and duly elected a Fellow of the Society.

The following papers were read:—

Observations of Coggia's Comet: by Mr. Joynson.

This paper contained a series of places of the comet on the nights of October 1st to 4th. On October 2nd the nucleus appeared to pass over or nearly over an 8th magnitude star, and when nearest, the star, small as it was, entirely put out the light of the comet, which was not visible again till they were distinctly separated.

Occultation of δ^3 Tauri: by Mr. Joynson.

On November 9, 1870, the moon passed over this star. The disappearance took place at 11h. 19m. 11·3s. G.M.T., and the reappearance at 12h. 16m. 50·7s. G.M.T. The observations were considered very satisfactory.

Note on the Proper Motion of Oeltzen's Argelander 17415–6: by Mr. Lynn.

This is a small 9th magnitude star found in Argelander's zones and inserted in Oeltzen's Catalogue, made from them under the above numbers. It was placed on the Greenwich Working List, but unfortunately with a wrong N.P.D., so that the observations made were not of Argelander's star. In August 1870 this error was found out, and the proper star has since been observed with the Greenwich Transit Circle. These observations were given in a table. The proper motion is considerable, amounting to 0·07s. R.A. and 1″·2 N.P.D.

On the Proper Motion of 36 (A) *Ophiuchi and* 30 *Scorpii*: by Mr. Lynn.

The well-known double star 36 Ophiuchi is about 13′ from the 7th magnitude star 30 Scorpii, and they both have a proper motion of considerable amount in the same direction. The binary star has a period of about 200 years. Tables of observations of the above stars were given; and the identity of motion may be seen from quoting the result in N.P.D., which is respectively 1″·0, 1″·05, and 1″·17.

On the Graphical Construction of a Solar Eclipse: by Prof. Cayley.

This paper was explained and illustrated with diagrams by the author. The design is to construct with a stereographic projection, and by aid of a scale of parts prepared for the purpose, a figure like those in the Nautical Almanack. The example shown was that of the coming Eclipse; and the author found that his construction agreed with calculation within 1·5m. of time, and 1° of latitude and longitude; but he thought, with greater care, these variations could be reduced to 0·5m. of time, and 0·5° of geographical position.

Mr. Browning exhibited and described his latest improved form of the Automatic Spectroscope, and illustrated the construction

by a movable diagram. He said that it might have been thought complete before, but he did not like the cam motion; and Mr. Proctor, looking into the necessary conditions, found it might be dispensed with by adding another bar at half the angle of the others; and thus keeping the face of the telescope always opposite to the face of the first prism. Mr. Proctor had also made another valuable suggestion, and he (Mr. B.) wished to acknowledge his great indebtedness to that gentleman for having pointed out such a simple method of completing the contrivance.

The papers being exhausted, the President invited observations or communications on any other matters of interest.

Mr. W. Simms said that, at the instance of Mr. Carrington, he would mention an observation which he should otherwise not have done. On October 11th he was trying a $2\frac{3}{4}$-inch telescope on α Lyræ, and saw a small star near, which, thinking it was the known companion, made him imagine he had got a first-rate glass. However, the position did not suit for that, and on the next night he found it in another position. It then occurred to him that it might be an asteroid; but on communicating with Mr. Lynn and Dr. Peters, they said it was not any of the known ones; and, on account of the great latitude, although it was possible, it was not probable that one should be there. It was known that there were many small stars about that part. The weather had not allowed any further observations.

The President: Then we may understand you have seen 2 stars near α Lyræ—the recognised companion and another?

Dr. De la Rue: What was the power?

Mr. Simms: About 120. The distance was about 30″.

The President drew a diagram of the group.

Mr. Simms: On the first night I saw the star higher and afterwards lower. The recognised companion I saw with a larger telescope.

Dr. De la Rue: Did you rotate the eye-piece?

Mr. Simms: Yes; it made no difference.

The President: It may be a variable star, but it is not very likely. I should recommend you to pursue the subject with the same telescope. Did other objects lead you to the conclusion that it was a particularly fine one?

Mr. Simms: No.

Mr. Lynn: I informed Mr. Hind of the observations made by Mr. Simms. Mr. H. made a good search in the neighbourhood, but found no moving body.

Dr. De la Rue said that as the minds of all were full of the *Eclipse*, which also caused the absence of so many friends, he would make a few remarks upon the subject of the nature of the Corona, which was the most important point the Expedition had

to clear up. The Corona consisted of two parts—one very near the sun, and undoubtedly belonging to it; the other extending far away from the dark moon, sometimes as much as 15′, and throwing out very curious rays and projections. It was extremely difficult to account for these. Mr. Lockyer had brought forward a theory that the Corona was an effect in our atmosphere; and Mr. Seabrook had written a paper to support him, and show that a portion of atmosphere within the cone of the shadow might be illuminated from without. The speaker's opinion was that part of the light might be produced in this way; but his principal object was to introduce a German paper, by *Oudemans*, to the notice of the meeting. This author supposed that, besides meteors and planets, our system is full of an immense number of fine particles moving in space round some centre, and which may be illuminated by the sun, and by parallax reflect light to us when the direct sunlight is cut off; and thus form a regular halo round the moon. The irregularities of the moon's edge would account for the projecting rays; and, if changes occur in these during the Eclipse, the moon's change of position equally accounts for the alterations.

Mr. Carrington: Oh! oh!

Dr. De la Rue thought the theory as good as any other at present.

Mr. Gibbs: Mr. Grove thinks that there is no such thing as the ether usually supposed to fill space. We should rather imagine some diffuse matter between the sun and moon, not definite particles. Something like the vapours in Dr. Tyndall's tube experiments, which are not one-millionth part of the weight of the surrounding air.

Dr. De la Rue: But still they are definite particles of matter, or the clouds would not be visible.

The President: Why, if space is full of these fine particles, do we not see light all over the sky at eclipses?

Mr. Dunkin: I am certainly somewhat impressed by Oudemans' paper, but it is a difficulty why the light should not be seen further. I have witnessed an eclipse, and think the Corona is something near either sun or moon.

Dr. De la Rue: It is probably near the moon.

Professor Selwyn: Why should a similar light not be seen when the moon is nearly new?

Dr. De la Rue: The sun and moon are not then in the same position as at an eclipse.

Professor Selwyn: They are very nearly so, and the light of the young moon is so very faint that it ought not to put out this illuminated matter.

Dr. De la Rue: The moon would not be less than two days

old for us to see it at all, and then the circumstances are very different. During an eclipse the sun is intensely bright while the moon acts as a screen in front of us; but in the other case, the sun is lower, or actually below the horizon. If you draw the positions you will see that, under these circumstances, the particles could not reflect any light to the earth. At an eclipse they are in the direct line from the sun to the earth.

Professor Selwyn: I should think the case I put more favourable than the other.

Mr. Lynn: I doubt if sufficient notice has been taken of a theory of Mr. Baxendell, connecting meteors and magnetic currents. As to the existence of a great number of meteors, it is corroborated by many phenomena.

The President: I have not seen his paper.

Mr. Lynn: The theory requires that the Corona should be elliptical; but though it is generally described as circular, there have been records of an elliptical shape.

Mr. Carrington: I do not think this shape has been seen.

Mr. Browning: At an eclipse in Chili it was so described.

Mr. Lynn: Some ellipses are nearly circular. Meteors may have short elliptical orbits as well as long.

Dr. Draper, of the United States, at the request of the Chairman, gave an account of a large *Telescope* recently constructed by his son, Dr. Henry Draper. It was a silvered-glass reflector of 28 inches aperture, on the Cassegrain plan, and of 13 feet focal length. The mounting was that of the German form of equatorial, under a dome 21 feet in diameter, and which, being mounted on a system of friction rollers, could be turned with two or three fingers. The tube was not solid, but consisted of a light wooden framework. So far as the trials in the workshop showed its character, it appeared to approximate to perfection. He had another telescope of 16 inches aperture, with which the moon had been photographed very successfully. In the new telescope the primary image of sun or moon would be six inches in diameter. Silvered-glass mirrors seemed to work better in America than in England. The 16-inch one was, after five or six years' use, as bright as ever. Possibly it was because when not in action the mirrors were covered up by a glass plate, resting on the edge, ground flat for the purpose. The glass of the great mirror is only about 1½ inch thick, and the silvering was done by the Rochelle salt process. The difficulty of supporting mirrors so as to avoid flexure is very great. Blankets were tried first and failed, but an India-rubber air bag seemed to succeed. Dr. Draper had made about 200 mirrors of different sizes. They were tested during completion by Foucault's method. There was a curious result with some. When looked

at in the direct axis they acted badly, but if tilted a few inches, as in the Herschelian view, they gave brilliant definition. With the 28-inch mirror a star showed a circle of light out of focus either way, and a dot with very little irradiation when in focus. The telescope will be erected and worked at Hastings, 20 miles north of New York.

Mr. Browning: I think the secret of keeping silvered-glass mirrors in good order is to let them alone, which no one here does. They are too fond of wiping them with dirty rags. I have one which came from Paris seven years ago and is as good as ever. My mirrors do not get dirty.

Dr. Draper: Mr. Rutherford, who lives in New York, is not so successful with his mirrors as we are. I think the sulphur in the gas of the city acts upon the silver. Damp is our great enemy, it splits up the silver from the glass.

Mr. Browning: All organic matter injures them. Many persons cover them with a piece of black velvet, which is a bad thing. I do not find wet hurts mirrors.

The President: No substance should touch them.

Dr. De la Rue: My experience differs from that of Mr. Browning. I had a mirror which kept bright for three years, but one day it got wet and the whole surface broke up. In another case the silvering of a solar eye-piece got spoilt. I find that silvered glass is not nearly so good as metallic mirrors. I have one 16 years old as good as ever.

Mr. Browning: In the case of Dr. De la Rue, he has not the anxiety of most people as to repolishing, having the means of doing it himself; but if you have to send a metal mirror to the optician, it may cost as much as it is worth, while a silvered glass can have a fresh coating deposited for a trifle. For the majority they are certainly the best.

The President: If a metal mirror be good originally, it is practicably indestructible.

Dr. De la Rue: I should have imagined, from the lightness of glass, that the flexure, when set on end, would not have been troublesome.

Dr. Draper: If you set a glass mirror in certain positions, it may appear optically perfect, but if turned round may be very bad. Many have been thrown aside on this account, which, if moved, might have done well. The glass is made by rolling, and gets a structure, which, when it stands one way, makes it better than in another. The best figure, we find, is given by hand, and not by machinery. The latter always produces a sort of pattern. The polisher must have a series of circles on it within one another. These break up the surface, and allow the air to circulate.

Mr. Lecky enquired whether the glass rested on the same bed, and was in its cell when polishing, as in the telescope?

Dr. Draper: It rests on an india-rubber bag with a hole in the centre, and has a rubber band round it. The excellence of the support is shown by there being practically no difference whether you look at a star in the zenith, or near the horizon. The glass mirror weighs 70 lbs.

The President: And Lord Rosse's $3\frac{1}{2}$ tons!

The meeting then adjourned.

Erratum in last Report: for *Captain* read *Colonel* Drayson.

CHANGES IN OUR ASTRAL HEAVENS.

α COLUMBÆ.—Is rising in the sky, and will continue to do so for 700 years more, when its greatest meridian altitude at London will be $4\frac{1}{2}°$, only slightly more than the present $4\frac{1}{3}°$. In 3,900 years it will cease to be visible.

FROMALHAUT.—First appeared above the horizon of London 1,700 years ago. In long. 90°, 8,400 years hence, it will attain its greatest meridian altitude, nearly 41°, and then begin to descend.

λ SCORPII; with *υ* called *Shaulah*, the sting. One of the lowest objects in our sky; meridian altitude, $1\frac{1}{2}°$. It is getting lower still, but can never disappear, its lat. being $13\frac{3}{4}°$, though 500 years from this its meridian altitude will be $\frac{1}{4}°$ less than at present; after which, in half the revolution of the equinoxes, or above 12,000 years, it will attain a meridian altitude of 48°, when of course the whole constellation of the Scorpion will be in the mid-heaven higher than Orion is now.

α LYRÆ, Wega; long. 283° 29′, lat. 61° 44′ N. Its meridian altitude at present is 77° 11′, but in 4,900 years hence, its long. being $352\frac{1}{4}°$, its declin. will be 51° 29′; so that it will be in the zenith of London.

α CYGNI. *Dheneb-al-dajâjeh*, the hen's tail; long. 333° 32′, lat. 59° 55′ Its meridian altitude at present is 83° 20′. In 1,700 years hence, in long. $356\frac{3}{4}°$, it will be in the zenith of London.

α AURIGÆ.—Though the meridian altitude of Capella is $84\frac{1}{3}°$, it can never reach the zenith, as its long. is about 80°; so that it has only something more than 700 years to rise, which will increase its meridian altitude only about $\frac{1}{2}°$, and leave it still 5° from the zenith.

α PERSEI. *Mirfak* ("the elbow"), or *Algenib* (*jeub*, "the side"); long. 60° 16′, lat. 30° 7′ N. Would be in the zenith of London in 660 years, in long. $69\frac{1}{2}°$. But allowing for the decrease of the obliquity of the ecliptic, the time is found to be 690 years, and its long. 69° 50′. It is now, when on the meridian, 2° 5′ below the zenith,

γ DRACONIS. *Etamin*, for *Râs-al-tannin*, "the Dragon's head." This famous star, only 1′ 40″ from the zenith, at the present rate of annual decrease of declination 0″·6, would be in the zenith in 167 years.

α CENTAURI; long. 237° 53°, lat. 42° 32′ S. Estimated by the globe, this fine star was still visible at the lat. of Greenwich when its long. was 181°, more accurately by calculation $180\frac{1}{2}°$; this was therefore 4,100 years before the present time, or B.C. 2,200 (epoch of Tower of Babel, common chronology). Previously to this it may have attained a meridian altitude of $38° 31′ + 23° 27′ - 42° 32′ = 19° 26′$ and $237° 53′ - 90° = 147° 53′$, which at the average rate of precession would take 10,600 years to accomplish, so

that B.C. 8,700 α Centauri had a meridian altitude of $19\frac{1}{2}°$. Estimating by globe, it will begin to be again visible at the lat. of Greenwich when its long. is $2°$, or by calculation $\frac{1}{2}°$, which would be 8,900 years from the present time.

α CRUCIS; long. $220°$, lat. $52° 53'$ S. In long. $153°$, 4,900 years ago, or B.C. 3,100, it was still visible at the lat. of Greenwich; and, being the lowest bright star in the Southern Cross, the whole constellation was then above the horizon. 9,300 years ago, or B.C. 7,400, its meridian altitude was $9°$. It will not be again visible at the lat. of Greenwich till its long. is about $149°$, or for 20,700 years.

CANOPUS. *Soheil*, α Argus; long. $193° 10'$, lat. $75° 51'$ S. When Canopus (Canobas) was in long. $180°$ it made its nearest approach to the horizon of London, above which of course it can never appear. This was 900 years ago, when it was $75° 51' - 38° 31' - 23° 27' = 13° 52'$ below the horizon.

α ERIDANI; long. $343° 8'$, lat. $59° 21'$ S. Achernar (*Akher-nahr*, the end of the river) will become visible in long. $55°$, at the lat. of London, 5,100 years hence; and 2,500 years after that it will attain its greatest meridian altitude, $2\frac{1}{2}°$.

The following will always be visible at London:—Upper part of head of Lupus and one of his fore legs; upper part of Corona Australis; all Saggitarius except the legs; a very little of the upper part of Piscis Australis; all Aquarius except a foot; most of the head, and a little of the back and tail of Cetus; head of Orion; part of head and neck of Monoceros; upper half of Canis Minor; head, neck, and tail of Hydra; upper part of Crater; wings and tail of Corvus; all of Scorpio except the curved part of its tail. Part of Argo Nabis can never be visible.

Proper Motions.—Whilst, as evident by the above illustrations, precession has materially changed and will change the aspect of the heavens in the course of many ages, these changes are only temporary, and come round in the known cycle of 25,868 years, and they do not affect the relative positions of the stars, whereas proper motions in vast periods of time would cause the permanent disruption of the present configurations of the stars, at least to a great extent. Humboldt observes,* "The Southern Cross will not always shine in the heavens in the same form which that constellation now presents, as the four stars of which it is composed move with unequal velocities in different paths. How many thousand years may be required for the entire dissolution of the constellation, is not to be calculated. As marked instances, the proper motion of Arcturus in 2,000 years is $1\frac{1}{4}°$; that of Sirius, $\frac{3}{4}°$; of Procyon, $43'$; μ Cassiopeiæ and 61 Cygni make $1\frac{2}{3}°$ in 1,000 years. The star 1830 Groombridge of 5·6 magnitude in Ursa Major has a motion of about $2° 8'$ in 1,000 years. Humboldt observes, "At the end of 3,000 years, about 20 stars will have altered their place $1°$ and upwards. It was remarked by Trontenelli, "There is a star in the Eagle (α) which, if all things continue their present course, will, after the lapse of a great number of ages, have to the west another star which at present appears to the east of it." † If ξ is meant by this star, the proper motion of Altair would cause both to have the same R. A. 5,800 years hence (assuming ξ to have no motion); after which Altair would have ξ to the west of it.

The stars α, β, γ Aquilæ are getting further and further from being in a line with each other. This arises from the large proper motion of α, both in R.A. and Decl., and a large proper motion of β in Decl. of the contrary sign to α. Some time ago therefore, when α had less R.A. and Decl. than at

* *Cosmos*, iii. p. 179. † Chambers' *Descriptive Astronomy*, p. 493.

present, and β was slightly less in R.A. and further north, these stars must have been exactly in a straight line (α is now about 9′ out of the line joining β and γ). Taking the data from the Radcliffe Catalogue, it would appear as the result of a graphical process that this was the case 700 years (approximately) ago. On the other hand, the stars of the belt of Orion have a tendency to get into a straight line. ϵ is at present about 5′ perpendicular distance below the line joining δ and ζ. Taking the motions for ζ from Speculum Harbrœllianum, and for the other two from the Radcliffe Catalogue, ζ is decreasing in R.A. and, as well as δ, decreasing in Decl. This evidently would ultimately bring them all on a line, and by trials graphically it would do so in about 9,000 years hence. This conclusion, however, must be taken with reserve, for the proper motions of δ and ζ are very small, and ϵ is assumed to have none; small corrections therefore in those data might greatly affect the numerical result.

From the recent very remarkable spectroscopic observations of Mr. Huggins, Sirius appears to be moving from us at the rate of 29·4 miles a second. We might at first be disposed to think that such a meteor-like velocity would, even after a moderate interval of time, produce some apparent effect on the parallax and brightness of the star; an idea, nevertheless, dispelled by a few figures. 29·4 miles a second is about 2½ millions (2,540,160 miles) in 24 hours. Dividing the Sun's distance, 91,430,000, by this, we have 36 days for the time in which Sirius passes over the Sun's distance from the earth. But Sirius, taking its parallax at 0″·15, is 1,375,100 times the Sun's distance from the earth. Supposing its motion to continue as at present till its parallax becomes 0″·10, this would give a distance of 2,062,650 times the Sun's distance from the earth; that is, an increase of distance one-half, or 687,550 times the Sun's distance, more than at present. By proportion this would be passed over in 67,767 years; the time required for the parallax of Sirius, moving as fast as assumed above, to be lessened only the 20th part of a second. The effect of this increased distance on its brightness will be found thus: Sirius, according to Sir John Herschel, is now four times as bright as α Centauri. Diminishing this in the inverse ratio of the square of the distance, if Sirius were removed to twice its actual distance it would still be as bright as α Centauri; and for a distance half as much more than the present, the proportion $(1·5)^2 : 1 :: 4 : 1·78$ shows that after moving at its present rate for nearly 68,000 years, Sirius would still be 1¾ times brighter than α Centauri.

Other changes in the heavens may be thus enumerated. Stars which have disappeared; new and temporary stars; variable stars: under which head some think the two preceding classes may finally be included. And if changes discernible only by the telescope are to be taken into account, some variable nebulæ, and the revolution of double and multiple stars round a common centre of gravity, have to be mentioned. Finally, there is the change of colour in certain stars, which in a few instances appears to be established: such as γ Leonis and γ Delphini, and Sirius, which Seneca describes as "redder than Mars," and which is classed as to colour by Ptolemy with Arcturus and Betelgeuza. (See Chambers' *Descriptive Astron.* p. 483; Smyth's *Cycle*, Vol. 1, p. 303; Humboldt's *Cosmos*, Vol. 3, pp. 112–114, 453.) Humboldt thought it probable that the change of colour of Sirius took place intermediately between the epoch of Ptolemy and that of the Arabian astronomers. (*Cosmos*, Vol. 3, p. 454.)

GEORGE F. WALKER.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

AURORÆ AND STORMS OF WIND.

Sir,—The assertion that Auroræ are "invariably" the forerunners of great gales should not, perhaps, be allowed to pass unchallenged. That this is the popular belief wherever the Northern Daybreak is frequently seen, is well known; and it might with safety be added that popular belief also connects these two grand sequences of phenomena, regarding the case as one of cause and effect. It is almost needless to remark that, even were Auroræ invariably followed by terrific storms, it would not therefore follow that one is the cause of the other, any more than that night is the cause of day because it has always succeeded day. Sir John Herschel says: "So far as has hitherto been proved, there is no meteorological effect either as regards temperature, moisture, barometric pressure, or wind, which is in the smallest perceptible degree influenced by its most vivid displays." And as regards the empirical law so widely believed, the following words of Kaenitz may be given: "Brilliant Auroræ which dart much into rays are frequently the precursors of gusts of wind, and of an abnormal distribution of heat over the surface of the globe."

However, as the late magnificent displays of the glories of the northern sky have given a fresh interest to all the suspected and known relations of the phenomenon—periodicity, sun-spot maximum, disturbance of the magnetic needles, &c.—the following extracts from my Meteorological Journal will perhaps be acceptable to many of your readers:—

Year	Date	Character of display	Weather a few days		Remarks
			Preceding	Following	
1865	Oct. 18	Fine	Calm, wet	Wind, hail, snow	
	„ 26	Fine	High winds	Cloudy, high winds	Gale on S.E. coast on 27th
1866	Feb. 21	Very fine	Frost, snow	Wet, hail	High wind on 23rd
	„ 25	Bright	Thaw, snow	Windy	
	Aug. 19	Faint	16th wet, windy; 18th fine	Cloudy	11th Sept. high wind
	Nov. 9	Faint	High winds	Windy	11th Nov. high wind
1867	Sept. 22	Bright	Cloudy	Gale on 23rd	
	„ 24	Faint	Cloudy	Cloudy	
	Oct. 2	Faint	Gale	Cold	Gale on 26th
1868	„ 19	Bright	Rainy	Cold	
	„ 21	Bright	Rainy	Cold	Gale on Nov. 1st
1869	March 2	Bright	Snow, hail; rapid fall of barometer	Snow, hail, rain	Windy on 5th
	May 13	Fine	Fine	Cloudy	
	Oct. 6	Fine	Cloudy	Rain	
1870	Jan. 3	Bright	Wind, rain	Showery	
	May 4	Faint	Thunder, snow, hail	Fine	
	Aug. 20	Bright	Fine	Cloudy	
	Sept. 3		Cloudy	Showery	Gale on 10th
	„ 24 „ 25	Fine	Fine	Fine	
	Oct. 14 „ 15	Fine	Wet	Wind, snow, rain	High wind on 17th
	„ 20		.. ..	Wet	
	„ 24 „ 25	Fine	.. ..	Rain, hail, thunder	Rain, hail, thunder

From these it will be seen that storms often precede the Aurora, that it seems to form part and parcel of a vast disturbance in earth and air and sky, or that it is one link in a splendid phenomenal chain. Perhaps the day is not far distant when we shall not only discover many other intermediate links, but even rise to the high discovery of a chain of causation.

Yours truly,
JOSEPH GLEDHILL.

SOLAR EYE-PIECES.

Sir,—I send a description of a set of solar eye-pieces, which I am now making for my 3-inch achromatic. Two are completed; the lenses I have ground myself.

These eye-pieces are of the ordinary Huyghenian form, but the two lenses are made of glass of two complementary colours, in order to produce a white image. The colours which I have preferred (after many experiments) are, a yellowish neutral tinted glass for the field-lens, and a blue glass for the eye-lens. This combination produces a clear white image, and as the eye-piece consists of two lenses only, all *additional* apparatus, such as screens, prisms, &c., is completely got rid of. There is no glare or haze in the field of view caused by the reflection of the solar rays by the interior surfaces of the lenses, and the definition is consequently hard and sharp. When the atmosphere is sufficiently tranquil, one of these eye-pieces, magnifying about 120 diameters, shows a faint interference line just outside the Sun's limb. I mount these lenses rather loosely in their cells, to allow for the expansion of the glass by the Sun's rays.

I notice that the nucleus of the large spot now traversing the Sun's disc is covered by a sort of gauzy veil, except an oval aperture nearly in the middle, which is very black. Round the border of this black hole the gauzy film is apparently deeper, and looks brighter, having the appearance of a nebulous ring. In moments of better definition (the atmospheric definition has been very bad lately) this nebulous ring appears granular or curdled.

I am, Sir.
Yours truly,
WILLIAM ANDREWS.

Gosford Green, Coventry:
Nov. 19, 1870.

JUPITER.

A general description of the principal features now to be seen during one rotation of this planet will probably be interesting to many and useful to some of the amateur readers of the *Register*. A glance at the disc at any given time will, with this assistance, enable those who cannot outwatch a long winter night to know what features will soon present themselves, and also to compute the time at which the most striking will appear.

Beginning with the fine southern band No. 6 (see *Register* for April 1870), it may be noted that this is the seat of great activity at present. One portion is but faintly seen, while the other is a broad band, containing two large bright spots. One of these lies close to the W. end of a short dark portion of the band; then for $4''+$ to the E. the band is brighter; at the E. end of this brighter part is the other bright circular spot, followed by a second dark patch. Again, band 5 is connected with band 6 by a broad

dark line under the first-mentioned dark portion of 6; and a very little to the E. of this a narrower dark line connects 5 with 4. No. 5 is now seen to join No. 4 a little to the W. of this point. About three hours after this group has passed the central line, a dark square cloud-like form is seen on No. 5: it is connected with No. 6 by a narrow dark line. Two large roughly-circular bright spaces may now be seen to the south-east of No. 6, which is now scarcely visible on the E.

No. 5, which is faint before the two bright spots in 6 appear, afterwards becomes the most striking band on the disc.

No. 2, hitherto the darkest and broadest band on the planet, is now showing signs of change. Dark projections may now be seen on its N. and S. edges: it is very broad but not dark in one part, and dark but not very broad in the other part of the sphere.

When the square form is seen on No. 5, one of these dark projections may be seen on the S. edge of 2, not far from the E. edge of the disc. The festoons in the central zone are seen almost always, when the definition is good.*

JOSEPH GLEDHILL, F.G.S., F.M.S.

Mr. E. Crossley's Observatory,
Park Road, Halifax.

ON A PHOTOGRAPH OF JUPITER.

By Mr. John Browning.

[Read at the November Meeting of the Royal Astronomical Society.]

On the evenings of the 24th and 25th of October, which will be remembered for the magnificent display of the Aurora Borealis, the air being steadier than usual, I made two careful drawings of the planet Jupiter. As these were made on successive evenings, the first on October 24th at 11 P.M., and the second on the 25th at 10.45 P.M., the drawings represent nearly the whole surface of the planet. The equatorial belt is of a fuller ochreish or tawny colour than when I last observed it during the previous apparition. A bright belt to the north of the equator is much the brightest portion of the planet's disc. The dark belts on the northern side were of a very dark brown, with less copper colour in them than I found during my previous observations. The portion of the disc to the south of the equator was peculiarly free from belts. This refers especially to the view obtained on the 24th. The hemisphere seen on the 25th had a bright and a dark belt about midway between the south pole and the equator, tolerably prominent. The ochreish belt was mottled all over the surface with white cloudy markings, or patches—a distinct line of them, though separated by darker markings between, evidently encircled the whole of the planet, a little way to the south of the true equator.

I began a series of very careful micrometric measurements of the relative measures of Jupiter, to endeavour to determine whether any change had taken place in the proportions of the polar and equatorial diameters, but owing to the very unfavorable state of the weather, I have not been able to complete these measurements.

Since writing the above, Lord Lindsay has shown me two photographic negatives of Jupiter, taken in Mr. De la Rue's observatory, within a quarter

* For the time, the dark square form on No. 5 was central at 11h. 55m. P.M. on the 16th of November. The eastern bright spot on No. 6 was central about 9 P.M. on the same night.

of an hour of the time I made my first drawing. It is worthy of remark, that the equatorial belt in these negatives is almost absolutely transparent: the light from this orange-coloured belt has failed entirely to act on the sensitive collodion surface. I have seen negatives of Jupiter taken during previous years in which this equatorial belt had exerted the most action on the surface, giving the belt as quite opaque. I have appended a rough diagram of this negative to my paper.

It seems to me probable that a careful examination of photographic negatives of Mars might throw some light on the disputed question of the colour of the darker portions of the planet. We have evidently not yet exhausted the application of photography to the cause of astronomical research.

THE MOON.

Sir,—From time to time the Moon controversy crops up in your columns, showing that the confusion on the subject is as great as ever. Now it is a great scandal to Astronomy that this question should thus linger on unsettled year after year. Many months ago I addressed you on the subject, maintaining that both sides were partially right—right as regards their own views, and wrong in denying their opponents'. The whole affair is simply this, that it depends upon what point the motion is referred to. If the motion be referred to the axis of the earth, then undoubtedly it is one of simple rotation round the earth, and therefore the Moon does not rotate on her axis; but if the motion be referred to the axis of the Moon, then the Moon does rotate on her axis, and this axis has a motion of translation round the earth. It will be asked, doubtless, why should Astronomers prefer the second mode of considering the motion rather than the first? I answer, because of the facility of computation, and because they desire to consider the motion of the Moon as they do the motion of other heavenly bodies. In the exceptional case of the Moon it might perhaps be simpler to refer the motion to the earth's axis, but if we attempted so to refer the motions of the planets, we should get into inextricable confusion. To all who are interested in this question, I would recommend the study of that chapter in Routh's *Rigid Dynamics* entitled "The Geometry of the Motion of a Rigid Body." I am, Sir, your obedient servant,

London: Dec. 12th. W. B. GIBBS.

METEOR.

Sir,—This evening (Sunday), while I was watching the stars, I noticed a remarkably fine meteor of an intense gold colour. It started from very near the star γ in Taurus, and travelled towards δ in Eridanus. It was larger even than Jupiter, and, the Moon shining with great splendour, I was astonished to see it so very brilliant. The time I observed it was near 6.15. As a subscriber to the *Register*, I have thought that this might interest some of our readers.

Believe me, Sir, yours truly,

14 Manilla Crescent, H. COX.
Weston-super-Mare: Dec. 4.

PUBLICATIONS OF THE ASTRONOMICAL SOCIETY.

Sir,—At the end of your report of the Meeting of the R. A. S., page 268 in the December number, I regret to see repeated the old story, *i.e.* "The Index to the first 29 vols. of the publications of the Society was completed, and would be distributed gratuitously to all Fellows applying for it, *but could not be sent by post.*"

This is saying: "We give to all," but in reality only giving to those Fellows resident in London or neighbourhood, for it is not even said that those who apply through a friend living in London will get copies.

Why not send it by post to all Fellows who would pay the postage, if it be too bulky to send post free?

This is surely not asking too much; if not heavy, the Index should be sent free, as the Society is now prosperous.

Sincerely yours,
J. M. S.

NEW COMET.

To the Editor of the *Times.*

Sir,—On the morning of the 24th Dec. Dr. Winnecke, of Carlsruhe, discovered a comet near the star Gamma Virginis, of which he has forwarded to me the following elements, calculated upon the first three mornings' observations:—

"Perihelion passage, dec. 19·836 Berlin mean time; longitude of perihelion, 9 deg. 26 min.; longitude ascending node, 94·15; inclination to ecliptic, 30·15; logarithm of perihelion distance, 9·63244; helio-centric motion, retrograde."

From these elements the subjoined places are computed; they apply to 18h. Berlin time:—

	R.A. ° ′	N.P.D. ° ′	Logarithm of distance from earth.
Nov. 29	221 26 ...	95 34 ...	9·6051
Dec. 1	234 36 ...	96 11 ...	9·6024
„ 3	247 20 ...	96 36 ...	9·6231
„ 5	258 27 ...	96 51 ...	9·6623

Dr. Winnecke remarks that the comet may become rather bright at its appearance in the evening.

I am, Sir, your most obedient servant,
J. R. HIND.

Mr. Bishop's Observatory, Twickenham.

Star Catalogue.—R. C. J. will find in the 3rd vol. of the *Astronomical Register*, p. 180 (1865), a notice of Ch. Dien's *Celestial Atlas* (Paris), with stars to the 9th magn. The Berlin Zones, in 24 charts, also go to the 9th magn. The *Atlas of Northern Stars*, made at the Bonn Observatory, is to 9½ magn. For catalogues, there is E. J. Cooper's, 60,000 ecliptic stars; Argelander's, 105,000 between +20° and +40°, and 108,000 stars between +41° and +90°; and Bessel's, from −15° to +15° 31,000 stars, and +15° to +45° 31,000 stars; others are given in Chambers' *Descriptive Astronomy.*—G. J. W.

Future Eclipses.—I believe the next very large eclipse of the Sun will be on April 17, 1912. In a list of eclipses I have by me I have seen the size of it stated at 11½ digits. From a careful computation

by Ferguson's tables, I cannot make it more than $7\frac{3}{4}$ digits. Will any of your readers kindly enlighten me on this point? Also, over what part of the United States the shadow of the total eclipse of July 29, 1878, will pass?—Astronomicus.

Brilliant Meteor.—Mr N. E. Green, of St. John's Wood, has forwarded us the following for publication. We have sent the original letter to Mr. A. S. Herschel.—"Towards the end of my late voyage from Australia in the *Superb*, when in lat. 48° N. long. 8°30′ W., bar. 29·76, ther. 60°, at about 9.45 p.m. October 18, I observed a brilliant meteor traversing the sky, from eastward, westward in the direction of the Milky Way. Its luminous tail was perceptibly divided in its entire length by a clear space, through which the stars could be seen. This divided tail, which had the appearance of a luminous vapour, remained clearly visible and defined from 10 to 15 minutes. At first it was straight, but it gradually became bent and serrated, and then slowly recurved itself, as if acted on by the prevailing wind, which was blowing moderately from westward, until it assumed the form of a cirro-cumulus cloud, and drifted away leeward. The weather was fine when I observed this meteor, but next day it became very unsettled."

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JANUARY 1871.

By W. R. Birt, F.R.A.S.

Day	* Supplement ☾ − ☉ Mid	Objects to be Observed
	° ′	
23	142 7	Mare Humboldtianum, Gauss.
24	130 7	Langrenus, Vandelinus, Petavius, and Furnerius.
25	118 28	Mare Nectaris, Isidorus, and Capella.
26	107 7	Fracastorius objects in the interior. †
27	96 2	Abulfeda, Almanon, and Tacitus.
28	85 7	Ptolemæus, Alphonsus, and Arzachel.
29	74 18	Sun-rise on Tycho, Straight Wall.
30	63 29	Plato, spots and streaks on the floor.
31	52 36	Mare Serenitatis, its dark border on the west.

* Supplement ☾ − ☉ is equal to the angle formed by the incident solar rays on the Moon's surface, and the same rays reflected from the Moon to the earth.

† Fracastorius. Several objects on the floor are connected by lucid streaks, some of which have been found to consist of minute craterlets.

Observations of the above objects may be sent to W. R. Birt, Cynthia Villa, Walthamstow.

SOLAR SPOTS.

Sir,—Many persons observed a spot on the Sun through the fog on the 18th ult., but its telescopic appearance deserves notice. With 2·9-inch refractor, and power 74, at $1\frac{3}{4}$ h., it was found to consist mainly of two umbræ of unequal size, the larger having an unusually large black nucleus, quite round, surrounded with a narrow grey ring, which was close to the

W. side of the umbra. There was also another black patch, of smaller dimensions, near the opposite side. The diameter of the large nucleus I estimated from subsequent measures of the umbra to be fully 20″. I have not seen any notice of a brighter ring surrounding the *nucleus* having been before observed, but the inference is obvious that its relation to the "cloudy stratum" of Dawes is analogous to that of the brighter inner edge of the penumbra to that part.

On the 20th at 10h., I could find but traces of 3 or 4 darker specks on a very dark umbra of very similar form, while some small spots E. had tiny black points in their umbræ.

I am, Sir, yours truly,

Dec. 14, 1870. T. H. BUFFHAM.

Description of the Cufic-Arabic Celestial Globe in the Borgian Museum Velletri; from the work of S. Asseman. Padua, 1790.

The inscription states that it was made by Caissar (Cæsar), son of Abi Alcasem Alabraki, by order of Mohamed Al Kamel (sixth king of the Jobite dynasty of Egypt, and a great patron of learned men), in the year of the Hegira 622 (corresponding to A.D. 1225: therefore twenty-seven years before the epoch of the Alphonsine Tables, and 212 years before the Tables of Ulugh Beigh); and that 16° 46′ was added to the places of the stars in the Almagest (in order to bring them up to the epoch of the globe: this is allowing 1° in sixty-six years for precession). The polar star on the globe is 5½° from the pole. The globe is made of brass or some yellow metal, and is of fine workmanship It has rude delineations of the forty-eight ancient constellations, engraved in double lines, between which is red enamel. The figures are represented fronting the spectator. The stars, embossed in silver and laid down to the 5th magnitude, inclusive, are represented by small circles of different sizes, without rays. The names of the principal stars and constellations are also in silver. The diameter of the globe is 8·6in., and with the four legs of its mounting the height is 19¾ inches. The Meridian and Horizon circles are divided, according to an ancient mode, into sixty principal parts, each of which is subdivided again into six. Two of the four curved legs (concave externally), one opposite to the other, are also graduated to correspond with quadrants of the Meridian Circle. The Zodiac has, besides the animal figures, the usual symbols for the signs.

The Cufic characters in which the names are engraved are very minute, contracted, and un-pointed; so that in some instances they have baffled the skill of the practical Orientalist Asseman to make out the meaning.

This very curious globe, probably one of the oldest astronomical instruments in existence (another is in the Mathematical Saloon at Dresden), appears to have been brought from Lusitania, and adorns the museum which was formed at Velletri, on the southern slope of the Alban hills, by the wealth and antiquarian zeal of Cardinal Stephen Borgia. The learned work of Asseman devoted to its illustration contains an explanation of the names and figures (the former are also given in the modern Arabic characters), and a commentary, with two planispheres made from the globe, and also a small drawing of the globe itself and its circles. A dissertation is added on the astronomy of the Arabians, with extracts from some of their astronomical writers, and two letters about the globe from the Astronomer Toaldo.

I hope to examine carefully the names on this globe, in order to note variations from those in the catalogue of Ulugh Beigh.

GEORGE J. WALKER.

ASTRONOMICAL OCCURRENCES FOR JAN. 1871.

DATE			Principal Occurrences	Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon —
Sun	1		Sidereal Time at Mean Noon, 18 42 47·0	3rd Oc. D. 1st Oc. D. 3rd Ec. R. 1st Ec. R.	11 13 14 31 15 43 52 17 14 12	8 13·2
Mon	2		Saturn's Ring: Major Axis = 34″·0 Minor Axis = 15″·1	2nd Ec. R. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	7 23 58 11 50 12 21 14 5 14 37	8 56·9
Tues	3		Meridian Passage of the Sun, 4m. 41s. after Mean Noon	1st Oc. D. „ Ec. R.	8 58 11 42 57	9 42·7
Wed	4	11 58 12 38 2 43	Occultation of ζ Tauri (3½) Reappearance of ditto Conjunction of Moon and Jupiter, 1° 32′ N.	1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	6 17 6 50 8 32 9 5	10 30·7
Thur	5	7 49	Occultation of μ Geminorum (3)	3rd Sh. E. 1st Ec. R. 2nd Oc. D.	5 56 6 11 48 16 55	11 20·8
Fri	6	9 24 9 30	○ Full Moon Occultation of δ Geminorum (3½) Eclipse of the Moon: visible at Greenwich			12 12·4
Sat	7	6 17 19 18 1 57	Occultation of μ^2 Cancri (5½) Occultation of η Cancri (6) Conjunction of Moon and Uranus, 0° 50′ S.	2nd Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	11 3 12 18 13 40 14 57	13 4·4
Sun	8			3rd Oc. D. 1st Oc. D. 3rd Oc. R. „ Ec. D.	14 34 16 17 17 7 17 16 17	13 55·9
Mon	9			2nd Oc. D. „ Ec. R. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	6 4 9 59 53 13 36 14 16 15 50 16 31	14 46·4
Tues	10			1st Oc. D. „ Ec. R.	10 43 13 38 12	15 35·6
Wed	11	10 15 11 14	Occultation of ν Virginis (4½) Reappearance of ditto	2nd Sh. E. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	4 17 8 2 8 45 10 17 11 0	16 23·8
Thur	12	7 11	Conjunction of Moon and Mars, 2° 39′ S.	1st Oc. D. 3rd Tr. E. „ Sh. I. 1st Ec. R. 3rd Sh. E.	5 10 6 55 7 16 8 7 6 9 56	17 11·7
Fri	13	18 57 15 23 4 6	☾ Moon's Last Quarter Occultation of 80 Virginis (6) Conjunction of Venus and Mercury, 3° 28′ N.	1st Tr. E. „ Sh. E.	4 44 5 29	18 0·3
Sat	14	15 25	Opposition of Uranus	2nd Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	13 23 14 55 16 0 17 35	18 50·7
Sun	15	14 27 15 20	Occultation of o^2 Libræ (6) Reappearance of ditto Illuminated portion of disk of Venus = 0·989 of Mars = 0·916			Jupiter — 9 26·1

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Mon	16		Sidereal Time at Mean Noon, 19 41 55·4	2nd Oc. D. ,, Ec. R. 1st Tr. I. ,, Sh. I.	8 22 12 35 45 15 22 16 11	Jupiter — 9 21·9
Tues	17	13 13	Inferior Conjunction of Mercury and the Sun	1st Oc. D. ,, Ec. R.	12 30 15 33 34	9 17·6
Wed	18	16 19	Conjunction of Moon and Saturn, 0° 16′ N.	2nd Tr. E. ,, Sh. E. 1st Tr. I. ,, Sh. I. ,, Tr. E. ,, Sh. E.	5 11 6 54 9 48 10 40 12 3 12 55	9 13·3
Thur	19		Meridian passage of the Sun, 10m. 57s. after Mean Noon	1st Oc. D. 3rd Tr. I. 1st Ec. R. 3rd Tr. E. ,, Sh. I. ,, Sh. E.	6 57 7. 47 10 2 30 10 22 11 16 13 57	9 9·1
Fri	20	12 32 0 45	● New Moon Conjunction of Moon and Mercury, 4° 48′ N.	1st Sh. I. ,, Tr. I. ,, Sh. E.	5 9 6 30 7 24	9 4·9
Sat	21	7 16	Conjunction of Moon and Venus, 1° 25′ N.	1st Ec. R. 2nd Tr. I.	4 31 20 15 45	9 0·7
Sun	22		Saturn's Ring: Major Axis = 34″·4 Minor Axis = 15″·12			8 56·5
Mon	23			2nd Oc. D. ,, Ec. R.	10 42 15 11 35	8 52·3
Tues	24			1st Oc. D.	14 18	8 48·1
Wed	25			2nd Sh. I. ,, Tr. E. ,, Sh. E. 1st Tr. I. ,, Sh. I. ,, Tr. E. ,, Sh. E.	6 52 7 34 9 32 11 36 12 35 13 51 14 50	8 43·9
Thur	26			1st Oc. D. 3rd Tr. I. 1st Ec. R. 3rd Tr. E. ,, Sh. I.	8 45 11 17 11 58 1 13 53 15 16	8 39·8
Fri	27			1st Tr. I. ,, Sh. I. ,, Tr. E. ,, Sh. E.	6 3 7 4 8 18 9 19	Moon — 5 26·3
Sat	28	1 14	☽ Moon's First Quarter	1st Ec. R.	6 26 53	6 8·4
Sun	29	h. m.				6 51·6
Mon	30	9 44	Occultation of δ^3 Tauri (5)	3rd Ec. D. ,, Ec. R. 2nd Oc. D.	5 18 17 7 50 46 13 5	7 36·4
Tues	31	6 27	Conjunction of Moon and Jupiter, 1° 44′ N.	1st Oc. D.	16 7	8 23·4

THE PLANETS FOR JANUARY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	20 10 15	−21 15	6″·8	1 27·2
	15th	20 9 13	17 25½	9″·8	0 1·2
Venus	1st	19 12 8	−23 20½	9″·8	0 29·3
	15th	20 27 6	20 29	9″·8	0 49·0
Mars	1st	12 7 22	+2 2	9″·4	17 21·7
	15th	12 23 1	0 39	10″·6	16 42·3
Jupiter	1st	5 11 46	+22 3	44″·4	10 27·3
	15th	5 5 41	22 28	43″·0	9 26·1
Uranus	1st	7 48 54	+21 38½	2″·4	13 4·0
	17th	7 45 59	21 46	2″·4	11 58·2
Neptune	1st	1 12 47	+5 5	—	6 28·9
	17th	1 13 6	5 56½	—	5 26·4

Mercury passes the meridian an hour and a half after noon on the 1st, the interval decreasing till the 17th, when the planet is in inferior conjunction with the Sun, up to which time it is an evening star and will be fairly visible.

Venus will be just visible in the evening, but so close to the Sun as to be scarcely worth observing.

Mars may be seen after midnight, but its diameter is too small to repay observation.

Jupiter is still as splendid an object as ever, rising at dusk.

Uranus is visible during the whole night.

ASTRONOMY IN THE TIME OF KING JAMES I.—In a household account-book of the revenue of England about 1610, among the officers about the King's person are: six surgeons at from 60*l.* to 30*l.* per ann.; three "phisitions," two at 100*l.*, one at 60*l.*; two "apothecaryes," at 26*l.* 13*s.* 4*d.* and 11*l.* 2*s.* 6*d.*—these to attend to the proper admixture of drugs, &c.; and an *Astronomer* at 20*l.* per ann., doubtless to prescribe the times at which the doses should best produce the desired effect, and how the baneful effects of malignant planets might be avoided. Our readers will probably agree that the salary was equal to the value of the services received.

New Equatorial Mounting.—We have had the pleasure of inspecting a very neat portable equatorial mounting by Messrs. Solomons, adapted to moderate-sized telescope, say from three to five feet in length. This stand is universal, and can be readily adapted to the latitude of any place of observation; it can also, by means of an efficient clamping screw, be rapidly adjusted in azimuth, and—a great desideratum—can be levelled by means of screws in the head of the stand; in fact, all necessary alterations can be accomplished without altering the position of the tripod.

Books Received.—We have to acknowledge, from Messrs. Sampson Low & Co., the Christmas number of the *Monthly Bulletin*, most admirably got up, and containing notices of recent foreign, colonial, and American publications; also of the *Publishers' Circular* of Dec. 17, which is a periodical most inexpensive, and yet most useful to all who wish to be well posted up in recent publications.

We owe our thanks to Mr. G. J. Walker for a work of great interest and research, entitled *Arabic Names of the Stars and Constellations*, which he kindly presents to our readers this month.

The Table of Contents.—" The old plan of having the Table of Contents for each month's number of the *Register* was far more convenient than that lately adopted of putting it on the first page, for it was far easier to find any article wanted while the numbers were *unbound*; and the Index of each volume renders the present Tables of Contents of no value. When it was outside on the cover, it was seen at once; now it has to be looked for inside, and each number opened."—J. Joynson.

[The Table of Contents was transferred from the wrapper to the body of the *Register* for the convenience of publication: a better plan is under consideration.—Ed.]

We will think over Mr. A. Woolsey Blacklock's suggestion with respect to printing Colonel Strange's figures for engraving on the scales of astronomical instruments.

Star Maps.—Mr. H. Cox will probably find what he wants in the *British Association Catalogue*, edited by Baily. The *Handbook of the Stars*, by Mr. Proctor, 1866, contains a complete list of stars up to the 5th magnitude.

New Books.—*A Monograph on the Total Eclipse of the Sun, as visible in Sicily*, by Signor Angelo Agnello. A new edition of Beer and Mädler's *Mappa Selenographica*, four sheets folio: Asher & Co., 13 Bedford Street, Covent Garden; price 1*l*. Guillemin's *The Sun*, translated by Phipson; 8vo. 6*s*. cl.

Sun Spot.—We are indebted to Mr. A. P. Holden for a beautiful photograph of some careful drawings made by him of a great sun spot observed at 8.0 A.M. on September 23, 24, 28, and 29, with a three-inch refractor, powers 60 and 130.

Will some reader of the *Astronomical Register* favour me with a few hints on protecting silver circle scales from tarnish? The circles of my equatorial got tarnished soon after I had it, and at the maker's suggestion, I covered the silver, after cleaning it, with some transparent varnish which he gave me. I found it impossible to apply this so that it should dry free from streakiness; but it answered my purpose till a few months ago, when, actuated by a desire to have a general clean up, I dissolved off the film of varnish, and now my silver circles are again black. This is annoying in more ways than one, and any regular polishing would soon impair the condition of the graduations. G. F. Chambers.

The November Meteors.—The November meteors were watched for on the morning of the 14th at Yale College, Connecticut, by six observers, who counted 153 in four hours and forty minutes. In 1869 the number was much larger, and in 1868 there were about 7,000 seen on one morning by a party of observers. From these observations, the inference is drawn that the great meteor stream had this year passed by the orbit of the earth at the time of observation in November. This belt of meteoric matter, it has been calculated, is about 1,000 millions of miles long and 50,000 miles thick, spreads over about one-fourth of its orbit, and has a velocity of 100,000 miles an hour. The November meteors, it is believed, will still be visible for several years, but in smaller numbers each year, until they disappear entirely, to return again in great splendour in the year 1900.

Eclipse of the Moon.—A partial eclipse of the moon, visible at Greenwich, will take place on the evening of the 6th of January, at about half-past six o'clock.

Greenwich Mean Time.		h.	m.
First contact with the Penumbra	Jan. 6,	6	27·3
" " Shadow	"	7	46·2
Middle of the Eclipse	"	9	16·4
Last contact with the Shadow	"	10	46·6
" " Penumbra	"	12	5·5

Magnitude of the Eclipse (Moon's diameter = 1) 0·688.

The first contact with the Shadow occurs at 130° from the north point of the Moon's limb towards the east; the last contact at 127° towards the west; for *direct* image.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1870.
Anthony, Dr.
Dawson, A.
De la Rue, W.
Erck, W.
Lean, W. S.
Little, W.
Ormester, H.
Ryley, F. B.

To March 1871.
Buffham, T. H.
Cook, James
Elger, T. G.

To April 1871.
Blacklock, A. W.

To June 1871.
Glover, E.
Guyon, G.
Jefferies, J.
Morton, Rev. J.
Squire, H.

To December 1871.
Andrews, W.
Bazley, T. S.
Clermont, Lord
Ellis, W. M.
Freeman, G. T.
Garnett, W.
Gilby, J.
Hall, Rev. R.
Joynson, J.
Longmaid, W. H.
Perrins, J. D.
Roberson, C.
Stanistreet, J. F.
Vallack, Rev. B.
Williams, G. (Liv.)

To June 1872.
Compton, A. S.

December 26, 1870. Subscriptions after this date in our next.

NOTICES TO CORRESPONDENTS.

We are again obliged to postpone several interesting communications.

We have again to request our correspondents to send their papers to us early in the month. They can scarcely realise the inconvenience caused to us by our endeavouring to give insertion to important papers arriving a day or two only before our going to press. Usually communications should be sent not later than the 15th, but we keep space up to the 20th for important letters, notices of recent phenomena, discoveries, &c.

Erratum.—In Walker's *Arabic Names of the Stars and Constellations*, p. 13, line 8, *for* Sa'd-al-Aula' *read* Sa'd-al-Bula'.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 98. FEBRUARY. 1871.

CONTENTS.

THE ECLIPSE EXPEDITION.

Owing to badness of weather and other causes there was much disappointment to almost all the observers. The most successful appear to have been Lord Lindsay (who really, as far as the chief object of his journey is concerned, viz., the obtaining of photographic pictures and drawings by eye-witnesses, had good success, as will be seen from our report of the meeting of the Royal Astronomical Society) and the Sicilian party. The distinguished observers who went to Oran, in Algeria, saw absolutely nothing. We fear that the observations made with the polariscope have proved failures. This is most disappointing, as it was of the utmost importance that they should be carefully and satisfactorily made. The *Saturday Review* gives the following account of the results, as far as they are at present known, of the Sicilian expedition:—

But it is time to describe what was actually seen by those of the expedition who were successful; and it is with great regret that we notice that among their number was not included Mr. Lockyer himself, to whose energy it was chiefly owing that success was achieved at all, and whose own observations would have been the most valuable, from his complete mastery of the science of spectroscopy, and the light which, by means of it especially, he has been able to throw upon the physical side of astronomy. We shall not attempt to enter into a minute discussion of the results gained, but will rather point out their general bearing; and this will be perhaps assisted by a few words of explanation. In total eclipses the sun is seen to be surrounded, first by the "chromosphere," a bright rim of reddish light, with an outline moderately well defined, presenting generally the same phenomena, though sometimes hidden when the moon happens to be particularly near the earth; and there is no reason to doubt that this consists

of a layer or layers of incandescent gas, chiefly hydrogen, arranged in order of density. Secondly, the coloured prominences projecting here and there from the edge of the chromosphere. These now present no difficulty whatever. They are discernible at all times by the Janssen-Lockyer method, and are known to be outbursts of heated hydrogen, many of them thousands of miles high, and constantly varying in position and magnitude. Thirdly, the corona. Of this sphinx of a phenomenon it is not only hard to say what it is, but even to say what it looks like; for while some observers on previous occasions have noticed only a finer halo surrounding the chromosphere, others have extended this into well-defined and gorgeous shapes, have given it brilliant streamers extending heaven knows how many diameters of the sun in length, and even an elaborate organism with bundles of parabolic rays. The American astronomers at the last eclipse declared that they found iron in its composition, even in that of these mysterious rays or streamers. What then does this eclipse reveal, as far as the accounts have come to hand? In the first place, there is a corona—which it is some relief to hear—and this corona is solar. The halo of which we spoke as surrounding the atmosphere is in fact an apparently achromic continuation of it; and it was observed by Professor Watson, well known in the United States as a patient and successful observer, to extend to about five minutes in height beyond the solar disc. He describes it as having the appearance of a shell, that well-known phenomenon of concentric layers which is presented by the nuclei of most comets which are near enough to be examined. Professor Watson also saw one of the "streamers" so often spoken of—and saw it disappear! It seemed to float away, he says, "like a veil." If, then, this observer is to be trusted—and there is no observer living who is more worthy of trust as regards a thing actually seen—the streamers are an atmospheric effect, and the corona, if we may continue to use the name, appears to be a solar envelope of gas surrounding the coloured gas of the chromosphere. Next comes the observations of the polariscope, some of which have not yet reached us, but those which have at present come to hand are distinct enough. Briefly stated, they are these:—The corona (or outer chromosphere) is strongly polarised; therefore it shines with reflected light. It is polarised in a plane different from that reflected from the moon's surface at the moment of totality; therefore it is not atmospheric. It may hence be fairly considered to be a solar appendage, reflecting in an eclipse the light of the obscured sun. Leaving further details, we turn lastly to the spectroscope; for, as no photographs have as yet reached England, it is too soon to pronounce on the value of those which have been made. The most important spectroscopic observation was made by Mr. Burton, an observer fully to be trusted, at Agosta. He saw in the first place the ordinary spectrum of the chromosphere, including a certain line in the yellow part never before noticed; then the hydrogen lines, which were to be expected especially at the edge of these, and which simply show the comparative lightness of the substance which produces them; and lastly—a most important discovery—a clear green line by itself outside the part of the spectrum due to the chromosphere, and at about the same position as that noticed by the American astronomers last year. What is this green line? It cannot well be a hydrogen line, for, if it were, why were not the other well-known lines of hydrogen present? It cannot be iron, for the same reason. It is like no substance in heaven or earth which is dreamt of in our philosophy. It is a gas—or shall we call it a metal?—which is so extremely light that it floats above the hydrogen, which is in the region of so low a temperature that it alone of the materials in its neighbourhood can yield any spectroscopic results, and which is green in colour. But for the fact that, as the polariscope shows, it shines chiefly by reflected light, this corona

would, at all events as far as this particular gas is concerned, be green; and as this is the very outside shell of all the shells of the sun hitherto discovered, we may even lay it down as an interesting fact in natural science that, as far as we know it, the sun is green on the outside. The only thing now left is that our chemists should produce this hitherto unknown substance in their laboratories, as they have already produced the similar thallium; or even, perhaps, the Janssen process may be repeated over again, and the workers with the spectroscope may not rest satisfied till they have traced this mysterious line in open day, and without the aid of an eclipse. Nay, what if it has been traced already? If this remote green line is the same which has been found in the aurora, and which is believed to have been found in the zodiacal light, what are we to say of such a discovery? Have we in any sense, with any limitations, touched the edge of that cosmical ether, that unknown substance, which everything points to and nothing shows, which is yet perhaps revealed under certain magnetic conditions in the higher regions of our atmosphere; and can this mysterious gas be nothing but a zone of the pervading ether itself rendered luminous by the intense heat of the sun? Perhaps this may be a conjecture to which sober science has no right as yet to proceed; but whatever the case may be, this green line in the spectrum of the outer chromosphere of the sun is the door by which those will for a long time enter in who wish to search with success the regions of cosmical science as yet unexplored.

It is very desirable that the Astronomical Society should, according to the suggestion of the Astronomer-Royal, appoint a committee to receive and digest all the reports which may be formally or otherwise brought before them, as it is only by such means that the real value of the various observations made can be ascertained.

We have received an interesting paper from the Rev. H. Ingram, on the eclipse of the sun, which we are obliged to postpone till our next number.

Mr. Buckingham writes—

The late eclipse of the sun was well seen here, and the principal phenomena that I observed were the following:—

1. A cord of extraordinarily brilliant light binding the edge of the moon; the effect, I suppose, of diffraction.

2. The perfect definition of the solar spots up to their disappearance behind the moon.

3. The perfect sharpness of the cusps.

4. The visibility of the moon's limb for a short way outside the cusps.

The diminution of light and the effects on the landscape at the time of greatest phase were very remarkable.

THE ECLIPSE OF THE MOON.

The weather was so unfavourable on the 6th that the eclipse of the Moon could not be observed at all in the East of London. We have received the following from Mr. Birmingham:—

Besides the scenic effects, which were very interesting, there was little to be noted.

A small red star was occulted at 8h. 21m. Dublin Mean Time, and the limb at the Leibnitz Mountains passed within 84″ of δ Geminorum, the small comes of which was easily seen. The outline of the shadow appeared to correspond very exactly with the field of an eye-piece that includes about 1° of space, which is much less than the diameter of the calculated shadow.

M. H. Cox, of Weston-super-Mare, writes :—"The eclipse of the Moon, on the 6th, was seen here at times very favourably, particularly between the hours of eight and nine, but from that hour it became very cloudy, and we only managed now and then to catch a quick glimpse of it."

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Third Meeting, January 13, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. Thirty-four presents were announced, and, in addition, a coloured sketch of the landscape effects during the Total Solar Eclipse, presented by Mr. Penrose. The thanks of the meeting were given to the respective donors.

Lord Lindsay,
T. Ribton, Esq.,
S. Cottam, Esq.,
J. Drew, Esq.,
Rev. J. C. Jackson,
W. H. Mahony Christie, Esq.,
and
Ankietani F. Nursing Row,

were balloted for, and duly elected Fellows of the Society.

Mr. Perigal, Mr. Penrose, and Mr. Gibbs, were duly appointed auditors of the Treasurer's accounts.

The following papers were announced and partly read; those on the Total Solar Eclipse, from members of the expeditions to Sicily, Cadiz, and Gibraltar, taking precedence :—

On the Solar Eclipse of December 22, 1870: by Mr. Ranyard.

The writer was happily favoured with fair weather, and by going up a hill with his instruments at Augusta, near Catania in Sicily, was able to report that there was strong radial polarisation from the corona and perpendicular polarisation from the atmosphere. His observations were corroborated by his companions, Mr. H. B. Samuelson, M.P., and Mr. Clifford, and they were all astonished at the strength of the polarisation.

Observations of the Total Solar Eclipse, by the Rev. J. Perry.

The author, being prevented by his lectures and observatory work from attending the meeting, sent the following short notes of the results obtained by the party under his charge. The salient points were :—

1. Form of Corona.—This was approximately quadrilateral, but not very well defined. Most extensive over the prominences. No radial streamers, but some gaps in the outline.

2. Within the corona was a narrow band of silvery light surrounding the moon's disc, and not exceeding one-tenth of its diameter. This band was uniform in colour and intensity and did not fade gradually into the light of the corona, but preserved a definite form.

3. The corona was hardly visible till totality was complete, but it continued to be seen some time after that phase was over.

4. As to the nature of the corona the results are negative only. The sky was never quite free from clouds, and the author could not get sufficient light through his powerful spectroscope; but Capt. Maclear, observing with a smaller instrument, saw some bright lines in the corona, which were also visible, but fainter, on the disc of the moon. This shows that the observations should be received with great caution.

Capt. Noble wished to make one remark, viz., that his friend, Mr. Watkins, of the R.A., who observed at Gibraltar, and had no preconceived theory to support, told him that the corona most undoubtedly followed the prominences, extending further whereever these occurred. This indicated beyond question that the corona was solar in its origin.

Mr. Hudson, as one of the Cadiz party, said that in one or two points he differed slightly from Mr. Perry's notes. The quadrilateral form was seen by all the party, but there were some interruptions in it. One gap was much larger than others. It is visible in the American photographs, and must have been a real vacancy, and not caused by clouds. The corona was seen before the totality and afterwards too. It was visible for 2m. 50s., the totality lasting only about 2m. 10s., so that 40s. or 42s. were in excess. It was difficult to distribute this period between the beginning and the end. Mr. Perry thought it lasted 35s. after the totality, which left only 5s. or 7s. for the beginning, but probably the clouds concealed it then, producing the apparent inequality. Mr. Perry says this was an unexpected effect, but he must mean only as to the eye observations, the speaker having been expressly asked to watch for such an event.

Capt. Maclear: I looked carefully with my spectroscope at a point in the corona, about 8′ from the moon's edge, at the commencement of the totality and saw several bright lines. I then moved to the centre of the moon's disc and saw the same bright lines, but fainter. I passed on to about 8′ from the limb on the other side and found the lines stronger again, and I think one more bright line made its appearance. I then went close to the limb and saw three more bright lines, two green and one blue,

between D and F. The light of the sun broke in and all disappeared, being replaced by the ordinary solar spectrum The corona gave no continuous spectrum, but only a faint and diffused light and bright lines. I recorded four such lines on one side of the moon and on its disc, and five on the other side. There were C, D or very near it, E, *b*, and F. I feel pretty sure of the identity of D and F, but the others were more uncertain. My only means of knowing them were the colours and my knowledge of their position in the spectroscope. The limit of 8′ from the moon's disc was used as part of my programme. The corona extended much further, and was of a silvery colour.

Dr. Huggins said that, with the view of saving trouble in making explanations during the discussion, it would be well to draw a distinction between the inner well-defined ring of white light, shown in a drawing by Lieutenant Brown and described by Father Perry, and the surrounding quantity of fainter and fading light. The term *lucosphere* had been suggested to distinguish the former from the chromosphere and corona.

Mr. Proctor suggested the terms *aureole* and *corona*, but

Dr. Huggins thought that as aureole had sometimes been applied to the whole corona, the word lucosphere would be better.

The Rev. F. Howlett said that Mr. Watkins showed his sketch to the speaker, and this distinctly proved the correspondence of the ring of silvery light, and not the corona generally, with the prominences which it followed round.

Capt. Noble: Mr. Watkins told me the *corona* followed the prominences, whatever he meant by the word corona.

Capt. Maclear, in answer to questions, said his instrument was a 4-inch refractor, equatorially mounted, with a Browning's pocket spectroscope adapted to it. He had no means of comparing the lines seen with those of gases or vapours. When observing the bright lines on the Moon's disc he did not rotate the eye-piece.

Mr. Hudson wished to remark that in Mr. Perry's report he had made no allusion to the polarisation observations, as he believed that the effects observed were all due to the surrounding light from clouds and the atmosphere. The plane of polarisation as noted by himself (Mr. Hudson), Mr. Ladd, and Mr. Baines, was the same whatever they looked at. He might also mention that the light on the moon's disc was greater than he should have supposed. It was nothing like so dark as he expected. The colour was green, and looked like green velvet, of the tint of the olives they had every day at dinner. When looked at with the double-image prism he got a sufficient amount of light to detect the change from light to darkness as the prism was rotated. The light of the clouds was more visible on the corona than on the Moon.

Mr. Ladd: I was using a plate of arragonite and a double-image prism, and saw the coloured rings of the crystal on the moon's disc, but not before the totality. The intensity increased during the totality. The same effect was produced beyond the corona, and was brightest over the corona itself, fading away outside. We set this down as due to the clouds and atmosphere. The plane of polarisation was, I believe, radial from the moon's disc. I tried both sides. My whole impression is, however, one of doubt.

Mr. Hudson: This direction of the plane does not agree with my impression nor that of Mr. Baines. We found it neither radial nor horizontal at the top and bottom of the moon's disc, but with an angle of 45° to the radius on the moon, on the corona, and on the moon's disc during the partial eclipse. These observations were not made all over the limb, but at three points at least. Clouds prevailed nearly up to the totality, but during this phase the effect was the same on the disc and on the corona. I attributed the whole to the clouds.

The Astronomer-Royal: It is clear that the question of polarisation is left just where it was. With regard to the different parts of the corona, I cannot do better than place before the meeting the representations made by Mr. F. Baily and myself in 1842. Mr. Baily observed at Pavia, where it was fine weather. I was at the Superga, near Turin, where it was cloudy. I saw a ring of light one-sixteenth of the breadth of the Moon, while Mr. Baily saw a quantity of light which surprised him, extending to the width of the moon's whole diameter. A comparison of the sketches shows that there is a narrow border of light, ring-formed, and also a quantity of light, radial and very extensive, which may have a very different origin, and be of great importance.

On the Total Solar Eclipse: by Lord Lindsay.

The author went out to Spain independently of the Government expedition, and arrived at Cadiz on December 4. There was some difficulty at the Custom-house, 800*l.* being demanded for duty; but after telegraphing to Madrid, and ventilation of the subject in the papers, the instruments were passed. A position about 14 miles from Cadiz, and not far from Xeres, was chosen, being a vineyard belonging to Mr. Campbell, who assisted the party in every possible way. The instruments comprised a $12\frac{1}{4}$-inch silvered glass reflector for photography. This was mounted equatorially for the author's observatory in Scotland, but being fixed on a strong wooden platform, was tilted so as to suit the latitude of the station. The weather was so bad that seven days elapsed before the proper adjustments could be made. The telescope was protected by a house, which was taken out with it,

measuring 20 feet by 11 feet—part being used as a dark room. The whole front could be opened when the pictures were to be taken. Other instruments were: a 6-inch equatorial, by Troughton and Simms, fitted with a Browning's star spectroscope, lent by Mr. Gill, of Aberdeen—this had one prism of 60°, and was used by Lieut. Brown, R.A.; an altazimuth, by Troughton and Simms, which was employed as a transit circle; and a 3¼-inch telescope, by Cooke. The weather continued most unfavourable, the 21st being the only really fine day. The 22nd was cloudy till eight o'clock; it then rained for half-an-hour, after which the sun became visible through thin clouds and the breaks in it. The party was at this time augmented by the arrival of Messrs. Reed, Pitman, and Greaves. The latter took charge of the telescope fitted for recording the position of the prominences. The others were to make eye-sketches of the corona. The first contact could not be observed, but several negatives were taken during the partial eclipse, until a small derangement of the slide happened. The totality then commenced, and the sky cleared for about a space equal to five diameters of the sun. The assistants were all at their posts. Mr. Rogers received the plates from the dark room, handed them to Lord Lindsay, and received them back from him after exposure. Messrs. Davies and Winslow were in the dark room, where they prepared and developed the plates, and Mr. Scott watched the finder. The party were all well drilled, and it was found possible to take twelve or fourteen pictures during the time of totality, but nine only were actually secured on the day of the eclipse, as the exposure of some was purposely lengthened. The totality lasted 2m. 8s., and one minute after clouds put an end to all further work. One positive has only yet been procured from the negatives, which was shown, and also a number of photographs of the observatory, instruments, and parties engaged. [The picture showed a number of prominences and the corona, much more extensive on one side than the other, being evidently one of the earliest taken.] Lord Lindsay then exhibited and explained the camera and dark slide. He tried to revert to the instantaneous apparatus after the totality, but the clouds stopped him. Six slides and six baths were in use during the operations. He received various reports from the other members of the observing party. The four sketchers were very successful. Mr. Becker and another observer worked with Nicol's prism, and Savart's band prism for polarisation, but could make no observations before totality, on account of the clouds. As totality approached the sky brightened. During totality polarisation was distinctly evident, but there was no difference between the moon's disc and the corona. The general effects were very grand; the sky became of a deep purple, and just

before totality some red and yellow tints came on, making the beholders livid and ghastly. The northern cusp of the sun broke up into a string of pearls at the last moment. A flock of geese came towards one of the party as if for protection, and the fowls huddled together as if going to roost. Lord Lindsay saw Venus and, he thought, one other star. The shadow advancing through the air was looked for, but not seen by any one.

The Astronomer-Royal handed in two short papers written by officers at Gibraltar, and sent to him by the Admiralty. They showed very different appearances of the corona. He suggested that as he was likely to receive more such communications, it would be desirable to appoint a committee of the President and a few others, to whom he would hand such papers, and they might then be compared with those sent to the Society, and the results given in a digested form, instead of letting each stand alone. He could also supply them with the records of the eclipse of 1860, which would be useful for comparison, although there were then only one set of observations with the polariscope, and none with the spectroscope.

Observations of the Solar Eclipse: by Lieut. Brown, R.A.

The author was attached to Lord Lindsay's party, and was stationed at his observatory erected in Mr. Campbell's grounds, about five miles from Xeres. His instrument was a 6-inch refractor of 7 feet focus, with a single prism spectroscope, by Browning. The telescope was equatorially mounted. The spectroscope had no automatic arrangement for recording the lines seen, but Lieut. Brown made a contrivance himself for this purpose, without which he could not have measured the lines. On the 18th December he measured and mapped the sun spots, several of which it was calculated would be on the disc at the time of the eclipse. One large spot had much changed its appearance by that time, while two others of a spiral form continued much the same. Lieut. Brown exhibited a large oil painting of the total eclipse, showing the prominences, the lucosphere, and an extensive corona. He also gave the times of contact with the spots, and noted that the moon's disc was darker than the umbra of the spots. He observed the bright lines of the prominences before and after the day of the eclipse: one of the protuberances thus seen was 30,000 miles high. He saw C, a line near D, E, and F. On the day of the eclipse the sky was very broken, and the first contact was lost. The large spot was near the edge of the disc, and was accurately delineated. No spots could be seen on the moon, neither could its disc be seen, except where it crossed the sun. No serrations were generally visible on the moon's limb, but on crossing the sun spots some jaggedness was seen. He then went to the spectroscope and

recorded the principal solar lines for comparison. The totality then commenced, and he adjusted the wires of the finder about 8′ from the moon's disc, where he got a continuous spectrum, with no lines either bright or dark; he closed the slit gradually, but no lines appeared; he examined the corona at various heights, but everywhere with the same result. He searched especially for Professor Young's line, but could find nothing. What the author calls the true corona is far higher and more diffused than the irregular pearly band close to the moon's disc. There were no lines in this latter portion; either none existed, or the haze obscured them. He looked in the finder and found the wires in good adjustment, and in the places he wished. Three prominences were examined: one marked B was tongue-shaped, and had been seen the day before, from which its position and form had been predicted. The corona had several gaps or bendings in. The achromatic chromosphere, or inner white ring, was free from rays. The rest of the corona was of a faint violet colour, very jagged at the borders and with great gaps, as shown in the drawing. For the inner portion, outside the chromosphere, he suggests the name of lucosphere. This ring surrounded some of the prominences but not others, and was pressed inwards at the gap in the corona. He believed the corona was entirely a solar appendage. The prominences were bright red, with a violet tinge at the upper edges. The tongue-shaped one seemed flattened at the top as if by blowing—perhaps the sun's rotation might have something to do with this. The drawing was made just after the totality, before he had seen the sketches of the other observers. The prominence B, examined by the spectroscope, gave the lines C, C^1 (near C), D, E, *b*, and *h*, their angular values being reduced to Kirchhoff's measures. It was about $2\frac{1}{2}$ minutes or 55,000 miles in height. Prominence A had six lines, which were not exactly measured. They were probably C, C^1, one near D, E, F, and G, and a short broken one near F. These lines were all shorter than those in B, and showed less change. The corona was again examined, with the same result as before. The wires were then placed on the gap, when the spectrum almost faded away, although the slit was widened and no lines were seen. The totality, which commenced at 14m. 52·5s., was over at 17m. 0·5s., giving 2m. 8s. for its duration. The ordinary spectrum and dark lines came into view, and clouds shut up the observations.

Dr. De La Rue wished to call attention to the results obtained by Lord Lindsay, and first to notice the enterprise and public spirit with which he had carried on his operations regardless of the refusal of Government aid, and independently of it. Having originally offered to join any such expedition, when the anticipated assistance was refused he still determined to go, and carried on his preparations as before. Referring to the single photograph

shown, in which the top was nearly the north point, it would be seen that on the side covered by the advancing moon there was little of the corona visible, while on the other side it was broad and extensive. Probably other photographs would show the reverse of this, as the eclipse progressed. This indicated that beyond the lucosphere there was something illuminated by the sun. This might be something near the moon, but beyond our atmosphere. He also noticed that there was no special bulging out of the corona over the prominences.

Mr. Proctor wished to be shown how anything near the moon could produce the corona, upon which a short discussion took place between him and Dr. De La Rue, each drawing diagrams to illustrate his views.

Mr. Proctor also drew attention to the likeness between Lieut. Brown's drawing and description, and those referred to by the Astronomer-Royal.

Mr. Hudson, in watching for the formation of the corona, became conscious of the presence of the moon's disc against the corona, which suggested that the light undoubtedly came from behind it.

Lieut. Brown: The moon was much darker than the surrounding sky.

The President: The moon during a solar eclipse is the blackest thing I know.

Capt. Noble: I have seen the moon's disc outside the sun at a partial eclipse in England. I should like to know whether, when the sketch was made, the sky was quite clear.

Lieut. Brown: Quite clear, but perhaps clouds formed a limit to the corona.

Capt. Noble: At Oran the weather was like a wet and windy day in October. On the day after we saw a halo round the sun through cirro-stratus clouds, and some here will recollect I said "I wish we could have seen the corona like this yesterday." It looked like a corona without an eclipse.

Lord Lindsay: There was the faintest trace of haze, but otherwise it was particularly clear during the totality.

Observations of the Total Solar Eclipse: by Mr. Abbay.

These were principally spectroscopic, and were made with an ordinary chemical spectroscope of two prisms, belonging to Professor Young. It was not adapted to any telescope. The slit was partly covered by a small prism for introducing spectra of comparison. The field included about 4°, and therefore took in a space equal to several diameters of the sun or moon. The spectroscope was carefully adjusted before totality, and showed the Fraunhofer line D single and B very black. These dark lines faded out and were replaced by three bright lines, in the positions of C, D, and F, and two others—one near *b* and another near F. There was no continuous spectrum, but the lines were

bright, on a dark ground, extending right across the field, and therefore not due to the prominences alone. Some of the lines were compared directly with the chemical elements, by means of an induction coil and vacuum tubes. After totality D was again seen as a single line, and four thick lines were noticed between E and *b*. The slit was about the 200th or 250th of an inch wide. The middle of the corona appeared to have a very distinctly marked radiate character. For half or two-thirds of its diameter it was of a pearly tint, and threw strong shadows, like moonlight does. Professor Winlock found Kirchhoff's line 1474 at the distance of three radii from the sun's limb, and considers it would have been found much further off on a finer day. From having no telescope attached to the spectroscope, Mr. Abbay could not specify the exact point he was observing; but as the whole field was full of the lines, he thinks the corona must be extensive. The hydrogen and iron lines were well identified by his comparisons.

Mr. Buckingham communicated some observations by an officer of a gunboat at Estipona, who saw three shoots of light, about the sun's diameter from its edge. He also observed Saturn about two diameters below the sun in the finder of Mr. Buckingham's large telescope. Mr. Buckingham lost the totality entirely through the clouds, but exhibited a number of photographs of his telescope, the scenery of Spain, and the members of the various parties, taken on board the *Urgent*.

The remaining papers were taken as read, including:—

Observations of the Solar Eclipse of December 22nd: by Baron de Rottenburgh.

Ditto, by Mr. Joynson.

Ditto, by Mr. Dancer.

Ditto, by Dr. Robinson.

Ditto, by Mr. Prince.

Ditto, by Mr. Talmage.

Ditto, by Professor P. Smyth.

Ditto, by Mr. Plummer.

Summary of Sun-spot Observations made at Kew during 1870: by Messrs. De La Rue, Stewart, and Loëwy.

On a presumed new Variable Star in Orion: by Rev. T. W. Webb.

Spots on Plato: by Mr. Birt.

On the Solar Eclipse of December 11, 1870: by Ragonotha Chary, Assistant, Madras Observatory.

On the change of Colour in the Equatorial Belt of Jupiter: by Mr. Browning.

Work done at the Kew Observatory: by Dr. De La Rue.

The meeting, which was a very crowded one, then adjourned.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE LATE SOLAR ECLIPSE.

Sir,—Being prevented at the last moment from proceeding to Gibraltar, to view the eclipse in its totality, I observed it here. First I noticed a notch in the sun's limb at 11.3, when it came out in a break between some clouds. I must have seen it to within half-a-minute of first contact. Directly afterwards the clouds thickened over the sun, and nothing more was visible till 11.31, when they commenced separating, and soon there was a large expanse of blue sky. Snow flakes kept falling during the first half of the eclipse. So far as I could judge with a telescope of 2¼-inch aperture, powers 70 and 150, the limb of the moon was pretty smooth. I wanted particularly to see whether the light of the sun would be dimmed at the time of the middle. From accounts of former eclipses, I was led to suppose there would be a little gloom when ten digits were covered. Nor was I disappointed. At the time of the greatest obscuration, and for about five minutes before, the light of the sun was most sensibly affected; the blue of the sky was beginning to assume a dark hue, and, as seen through trees, the impression was that of an approaching storm. I endeavoured to catch Venus with the small telescope, but failed. The sky was very favourable for observing the latter half of the eclipse. It was interesting to watch the moon's limb recede over two large groups of spots. The last contact, at 1.38 (railway time), I observed very distinctly. The minimum thermometer stood at 25° during the eclipse, and there was no perceptible fall in thermometer or barometer.

Yours faithfully,
S. J. JOHNSON.

Upton Helions Rectory,
Devon.

THE TRAPEZIUM IN THE NEBULA OF ORION.

Sir,—I was glad to see the letter of Mr. S. S. Broughton, in the last number of the *Astronomical Register*. The Trapezium in Orion is an exquisite object, and the question whether or not the component stars are variable has never received sufficient attention. But this is not surprising when we consider that there are but few observers who have appliances sufficiently powerful, and the time to successfully examine it. Mr. Broughton remarks that he cannot find any recorded observations since 1866–7, and also speaks of the desirability of astronomers obtaining numerous observations of the object during the winter evenings. Your correspondent may be interested in learning that the late Mr. Edmund Salter, of Manchester (whose untimely death you referred to in your November number), observed on several occasions 9 stars in the Trapezium, and has more than once suspected the existence of a 10th. On December 3, 1869, and on January 25 and 29, 1870, he saw 9 "certainly," and 10 "probably." Mr. Salter seems to have noticed no variation in the brilliancy of any of the small stars, although he made sketches of their positions, and numbered them in the order of their brilliancy. His drawings almost perfectly coincide with Mr. Huggins' sketch of the Trapezium, which appears on page 55 of the *Register* for 1867.

The 10th star, which Mr. Salter thought could be seen by "glimpses," was situated a little to the east of δ in the sketch made by Mr. Huggins.

There can be no doubt that Mr. Salter possessed very excellent vision, and that his telescope (a 12-in. reflector, mirror made by Mr. F. Bird, power generally used 320) was one of very good definition and great space-penetrating power.

Owing to the want of sufficient evidence, it is impossible to decide whether the small stars in the Trapezium are variable or not. It would certainly appear that they are, if we are to judge from the observations made by Mr. John Browning on January 25 and 26, 1867. In a letter to the *Register* of March 1867, he says that on the former date he "saw 6 stars in the Trapezium, the star marked 6 in the diagram I enclose being easily visible, while the star marked 5 could only be glimpsed at intervals." On January he again observed it, and to his surprise "the star marked 6 was barely perceptible, while the star marked 5 was very plainly seen." Practised observers verified these observations, and Mr. Browning asks, "Can the stars I have alluded to be rapidly variable?" This question has never been answered, and it really appears that Mr. Salter is the only one who has recorded his observations of this object since 1867. Under these circumstances it is advisable that observers working with large apertures should, on all favourable occasions, critically examine the object, and note the relative brilliancy of the component stars. I contemplate making numerous observations of it during the ensuing winter with my $10\frac{1}{4}$-inch Browning reflector, and shall be glad to receive the results of other observers for comparison. If this plan is carried out, it will be easy to determine the various periods of the stars, should they be found to be variable.

As I have before referred to the late Mr. Salter, it may be appropriate to mention here that on January 15, 1870, he observed "19 spots or craterlets on the floor of the lunar crater Plato." This is more, I believe, than has ever been seen at one time by any other observer.

I am, Sir, truly yours,

Ashley Road, Bristol: WILLIAM F. DENNING,
December 1, 1870. Hon. Sec. Observing Astronomical Society.

STAR CATALOGUES.

Sir,—In addition to the information upon Star Catalogues given in your last by G. J. W., the following may perhaps be useful:—

Besides those two catalogues by Argelander, mentioned by G. J. W., there is another, containing 110,984 stars, situated between 2° south and 20° north declination; the epoch for the three catalogues is 1855. They were published at Bonn.

Argelander's *Northern Zone Observations*, 45° to 80°, have been reduced by Oeltzen, epoch 1842; Oeltzen's *Argelander* contains tables for precession. The work was published in Vienna.

Bessel's *Observations* have been reduced by Weisse, epoch 1825. Weisse's *Bessel*, 45° to 15 north declination, gives the precessions to the stars; W. B. north 15° to south 15° gives the precessions and secular variations; W. B. was published in Petersburg.

Argelander's 199 *Southern Zones*, containing 17,600 stars, from 15° to 31° south declination, are in one quarto volume of his partially reduced observations, and the observations require further reduction, which may be very easily done by the use of the tables on the same pages as the observations, together with some small tables (12mo.—99 pages) prepared for these observations. Published at Bonn.

The observations have been completely reduced, and rendered more convenient, by Oeltzen, who also has given tables for precession. O.A. southern zones must, however, be sought for in 6 parts (1857–8) of the *Sitzungsberichte der Kaiserlichen Akademie*, &c. (published in Vienna), 1,780 pages in all, of which O. A. takes up 444 pages. The epoch for these stars is 1850.

For stars within 9° of the North Pole, Carrington's *Redhill Catalogue of 3,735 Circumpolar Stars* (epoch 1855) is very valuable; it contains, besides much other matter, the numbers &c. necessary for calculating the precessions of the stars by Bessel's method. Published by Longmans.

Yours truly,
T. W.

THE AURORA OF OCTOBER 24th, 1870.

Sir,—In the various accounts which I have read of the grand auroral display of October 24th, I have not seen any mention made of the beautiful *triple arch* which formed, at one time, so conspicuous a feature of the phenomenon. The following extracts from my journal may therefore prove interesting to those who had not the opportunity of watching the remarkable changes which occurred. At 6h. 30′ P.M., I observed a strong auroral light over the whole northern sky. At 7·15 P.M. a very wide arch extended from the horizon, just below Capella, and passing between Ursa Major and Polaris, reached the western horizon and enveloped Corona Borealis. At the same time an arch of white auroral light extended from the western part of Aquila, and, passing below the square of Andromeda, Aries, and the Pleiades, reached as far as Aldebaran. This arch lasted only a few minutes. At 7·55 a magnificent carmine streamer, having on its western margin a narrow bluish one, darted up from the eastern extremity of the northern arch to Capella, and in a few moments extended itself nearly to the zenith. At 7·58 innumerable and beautiful streamers of a greenish colour darted up from the entire length of the northern arch, and various patches of carmine cloud appeared to the westward. At 7·59 a brilliant carmine canopy appeared over the zenith, and the southern arch, first seen at 7h. 15′, re-appeared. At 8·5 two more arches of white auroral light appeared suddenly below the aforesaid arch, each about 2° wide, and the same distance the one from the other; the whole forming a *magnificent triple arch*, situated to the south of the zenith of my observatory, and which doubtless formed that portion of the aurora which was seen in Italy and Malta. The two southerly arches did not continue more than three minutes, and never re-appeared. At 8·10 Jupiter, Auriga, Perseus, Aries, Cassiopeia, Draco, Lyra, and Aquila, were enveloped in one large and splendid carmine cloud. At 8h. 12′ the brilliancy had somewhat diminished, but there were still fine streamers, of a somewhat carmine colour and conical form, darting up towards the zenith from the whole horizon (ENE. by N. to WSW.) At 8·15 there were patches of carmine cloud in NE., NW., and SW., and a magnificent carmine arch extended from Jupiter through Taurus, Aries, Andromeda, and Aquila to a mass of pink aurora in WSW. This arch was the most northern of the triple arch mentioned above. At 8·17 this arch suddenly lost its carmine colour and became white, and slightly broken at its greatest convexity. At 8h. 25′ it became perfect again, and assumed its former pink colour. About this time there was a pinkish glow over the whole northern sky. At 8·28 a low white arch appeared beneath Ursa Major. At 8·30 aurora much diminished everywhere, with the exception of that portion in Auriga, Perseus, Taurus, and Aries, from which some white streamers projected into Andromeda. At 8·35 some carmine streamers appeared in Auriga, and a very

white cloud in Andromeda, which lasted only a minute. At 8·41 two small detached portions of aurora, the one pink and the other white, each about one degree wide and five long, arranged themselves at right angles, the one to the other, near γ Andromeda; the former lying horizontally E. and W., the latter vertically N. and S. At 8·43 the aurora was still more diminished in brilliancy. At 9h. there was a strong white auroral light in the north, from which numerous streamers from time to time appeared, but the whole gradually drifted away to the NW., and at 10h. 15′ had disappeared.

The Aurora of October 25th was very inferior to that of 24th, but it was remarkable that the splendid auroral arch which extended several times from ENE. to WSW. on 24th, appeared and disappeared several times on the evening of 25th also, and exhibited, momentarily, very similar tints.

Yours obediently,

C. L. PRINCE.

Observatory, Uckfield:
January 3, 1871.

A REMARKABLE METEOR.

Sir,—If you have not received further accounts of a remarkable meteor, of which I only partially obtained a glimpse on Monday, January 9th, you will perhaps deem this notice worthy of insertion in the pages of the *Astronomical Register*.

1871, Jan. 9d. 10h. 10m. G. M. T., while directing telescope to the constellation of Orion, I was startled by a glare of light in the observatory, and on quickly moving to the slit, I saw a splendid cluster of meteors pass rapidly across that constellation from east to west, in a line nearly parallel to the equator, about half way between the belt and shoulders.

I should think that the meteor was visible for five seconds, of which I only saw it during the two last; it left a broad short train, which faded away in about three more seconds.

The meteor consisted of detached portions, making up a globular cluster of about the apparent size of the moon. In that space I estimate roughly that there were 8 to 12 separate meteorites.

The sky was clear, and the moon (just three days past the full) very bright, and I estimate the light of the meteor to have been about 1½ times that of the moon; its colour was nearly that of the mercurial electric light.

I am, Sir, your obedient servant,

R. C. JOHNSON.

Warrenside, Blundellsands, Liverpool.

Sir,—On the evening of the 9th of January, about 10 o'clock P.M., the night being remarkably clear, and the moon shining with great splendour, I saw one of the finest meteors I ever saw in my life; had the night been dark I believe it would have illuminated the whole heavens. It appeared near Beta Cassiopeiæ, and disappeared near the 5th mag. star Theta Andromedæ. Time of flight about 4 seconds—course straight.

Yours most respectfully,

Wolverhampton. HENRY SQUIRE.

MOCK MOONS.

Sir,—On Sunday evening last, while returning with a friend from Lawrence St. Lydeard to Wiveliscombe—the sky was partially covered with light fleecy clouds, and a ring or halo was formed around the moon, about 50° in diameter; the lower part was obscured by a bank of clouds—I saw two mock-moons or paraselenæ appear on the halo to the north and south of the moon. The sides towards the moon were of a light orange colour, and whitish beams of light shot out from them in an opposite direction. It was freezing at the time. This phenomenon lasted about twenty minutes. On arriving in the town I learnt that the same had been witnessed by persons there. As a subscriber to the *Astronomical Register*, I have thought that this may interest some of your readers. I should feel obliged if some kind reader would inform me of a work giving an account of such a phenomenon being seen in *this country*.

Yours respectfully,

Wiveliscombe, Somerset: Jan. 12. J. WEBB.

RECENT CHANGES IN JUPITER.

Previous to the 25th of last November, the *North Temperate* belt of Webb [*Pop. Sci. Review*, April 1870], or Mr. Gledhill's No. 2 [*Ast. Register*, April 1870], seemed to me remarkably persistent in its features; but on that night it exhibited two dark patches not previously seen. From this to the night of December 22 I was not able to observe; but then, after the planet had made 65 revolutions on his axis, the spots appeared again in the same position. On both occasions Webb's *South Sub-Torrid* belt (Gledhill's No. 5) was incomplete toward the west. This latter belt showed two similar patches or protuberances, chiefly projecting toward the south, on January 10, at 11h. 30m. G. M. T., and, an hour-and-a-half afterwards, a third became visible to the east of the others, which had now advanced considerably toward the limb, and, I think, a bright spot separated it from its neighbour. I never remarked any spots on this belt previously.

On November 25, at 10h. 25m., I saw a large dark spot, also new to me, on Webb's *South Temperate* belt (Gledhill's No. 6), No. 5 being at the same time incomplete toward the east.

Without being able to detect, with my very inferior means, the more minute features described in the last *Register* by Mr. Gledhill, I am glad still to be able to confirm in a general way his observations of recent changes in the appearance of Jupiter; and the three spots on his No. 5 belt, seen by me on January 10, and not alluded to by him, may be instances of further change developed since his communication.

J. BIRMINGHAM.

Millbrook, Tuam:
Jan. 12, 1871.

EPSILON LYRÆ.

Sir,—Amongst the many stellar objects with which astronomers are familiar, there are probably none more interesting than the beautiful group known as E Lyræ. Even in an instrument of less than three inches aperture, when properly separated by adequate power, they present a spectacle to which the observer ever returns with a keener appreciation of its unique

simplicity and grandeur. It is, however, the minute points of light in the immediate vicinity of this group which renders it of value to the practical observer, offering, as it does, several excellent tests for the light-gathering powers of large instruments.

Having devoted a considerable time last summer to observations of this group, with especial reference to its more minute members, I have obtained some estimate of their relative brilliancy, which may possibly be useful for comparison with the results obtained from more powerful instruments. The telescope I use is a refractor of 3-inches aperture, the object-glass being a very fine one by Browning, which bears readily a power of 300.

In the *Register*, Vol. 2, page 301, there is a communication from the late respected observer, Mr. Dawes, dealing with the whole group, and giving a diagram of them. The sketch shows the two doubles with the "debilissima" couple between them, and the brighter star following. Immediately in front, and a little to the south of the "debilissima," is another pair, and again, at a similar distance in front of these, a third pair. With 3·8 inches, Mr. Dawes had perceived the "debilissima" distinctly, also several very minute stars preceding them. Other observers had also perceived them, but with much larger apertures.

The first time I observed this group was with an inferior 3-inch glass, in May 1869, being at that time quite unaware of the existence of any other stars in this group besides the doubles. On this occasion I at once glimpsed the southernmost of the "debilissima," and after a time also saw the other one, and made a sketch of them. This sketch was afterwards compared, by a friend, with the one by Mr. Dawes referred to, and was pronounced identical with it, as far as the two stars were concerned. Observing the group again in March 1870 with the improved 3-inch glass, I glimpsed, in addition to the "debilissima," a minute star S. p. them, and considerably to the north of these another, immediately preceding E^1. These two stars formed a trapezium with E^1 and E^2. In May, the star just referred to as "immediately p. $E.^1$" was *steadily seen* on all occasions; indeed, although, of course, not so bright, it yet was quite as easily seen as the 9th mag. star *f* the group. It is readily found, from the fact that it forms a right-angled triangle with E^1 and E^2. The comes S. p., the southernmost of the "debilissima," was also glimpsed frequently. On these occasions I became aware of the existence of two other stars, which from their proximity to the group may, I think, be legitimately termed a fourth pair. They are situate immediately to the north of the northernmost of the third pair, and at almost the same angle and distance apart as the "debilissima," but are rather brighter.

To sum up the whole group as observed upon these several occasions, I think that I may safely put them in the following order of brilliancy, calling the various pairs in their order of distance, from a line joining E^1 and E^2, No. 1 (the "debilissima"), No. 2, No. 3, and No. 4 (the new pair).

The most visible object is the 9th mag. star *f*. The next most readily seen is the northernmost of pair No. 3, which, as I before remarked, forms a right-angled triangle with E^1 and E^2, and was readily seen on all occasions, being apparently about the 10th mag. The next in order of brilliancy is, I think, the new pair, No. 4, whose magnitudes are pretty nearly equal, and probably about 10·5 or 11. After these, the next easiest is decidedly the preceding one of the "debilissima," its companion being a little more feeble in lustre. Webb gives them both 13th mag., but the *p.* one is certainly brighter than this. I think we may safely put down the southernmost of pair No. 2 as the next most difficult, as I could only glimpse this on rare occasions, whilst the northernmost of No. 2 pair, and

the southernmost of No. 3, have always been beyond my eye and instrument.

From a consideration of these facts (which have only been noted down after many careful observations), it would seem as though some of the objects had brightened somewhat since the time when even the "debilissima" resisted Herschel's 5-inch achromatic. A perfect knowledge, however, of the situation of the companions (although I had not this aid when I picked up the "debilissima") may have rendered some of the objects easier.

I trust that some other observers will communicate the results obtained by the use of large apertures, as they would be useful for comparison, and also serve to show whether I have placed the members of this group in their proper order of brilliancy.

I remain, yours faithfully,
ALBERT P. HOLDEN.

Hoxton Street, N.: Jan. 7, 1871.

OCCULTATION OF URANUS.—On Friday, February the 3rd, an occultation of Uranus will take place at 6h. 14m. The planet will reappear at 6h. 57m.

THE GREAT MELBOURNE EQUATORIAL.—We have received from M. Grubb a pamphlet, in reply to the charges made against this instrument. The crowded state of our pages prevents us giving extracts, but we shall do so as soon as space permits.

PRIVATE OBSERVATORIES. — A valued correspondent writes: "Would not something, in pursuance of the suggestion by T. G. R., given in the *Register*, No. 88, be likely to interest many of its readers? A direct re-appeal to its subscribers might be likely to elicit a large proportion of the requisite information. I cannot but believe that if a *direct* request were made, with particulars desired, and a limited time named within which the return should be forwarded, that it would be very generally responded to, and that owners of observatories, who may not be subscribers to the *Astronomical Register*, would be equally willing to furnish the small amount of information required, if the request could be brought under their notice." T. W. [We received but few replies to our last request on this subject; but when our pages are a little less occupied we will give special attention to the matter, and trust to be able to produce a tolerably faithful list of private observatories.—ED.]

THE SUN.—M. Gauthier-Villars, the scientific publisher, has completed the publication of Father Secchi's work on the Sun. It comprises more than four hundred octavo pages, and will certainly be largely circulated when Paris is open. Father Secchi has written it in French, having secured the assistance of some learned Jesuits. It is not, however, merely a translation of his former Italian work on the same subject.

Owing to a misapprehension, the paper on the Astral Heavens was not properly corrected. We submit the following errata:—Page 290, line 15 from bottom, for *jeub* read *jenb*; page 291, line 11 from bottom, for Trontenelli read Fontenelle; line 12, for Canobas read Canobos; line 15 from bottom, for make read move; line 21, for Saggitarius read Sagittarius; line 27, for Nabis read Navis; page 292, line 8, for Harbrœllianum read Hartwellianum; line 14, for might read would; page 299, line 14 from bottom, for practical read practised.

ASTRONOMICAL OCCURRENCES FOR FEB. 1871.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon —
Wed	1		Sidereal Time at Mean Noon, 20h. 45m. 0·30	2nd Tr. I. ,, Sh. E. ,, Tr. E. ,, Sh. E. 1st Tr. I. ,, Sh. I.	7 22 9 29 10 0 12 10 13 25 14 30	9 12·5
Thur	2			1st Oc. D. ,, Ec. R. 3rd Tr. I.	10 34 13 53 39 14 52	10 3·7
Fri	3	6 14 6 57 7 35	Occultation of Uranus Reappearance of ditto Conjunction of Moon and Uranus, 0° 43′ S.	2nd Ec. R. 1st Tr. I. ,, Sh. I. ,, Tr. E. ,, Sh. E.	7 5 14 7 52 8 59 10 7 11 14	10 55·9
Sat	4		Meridian Passage of the Sun, 14m. 10s. after Mean Noon	1st Oc. D. ,, Ec. R.	5 2 8 22 32	11 48·4
Sun	5	2 1	○ Full Moon	1st Sh. E.	5 43	12 40·3
Mon	6			3rd Oc. R. ,, Ec. D. ,, Ec. R. 2nd Oc. D.	7 16 9 18 35 11 52 13 15 29	Jupiter — 7 55·1
Tues	7					7 51·1
Wed	8	20 17	Conjunction of Moon and Mars, 1° 55′ S.	2nd Tr. I. ,, Sh. I. ,, Tr. E. ,, Sh. E. 1st Tr. I.	9 50 12 7 12 28 14 49 15 15	7 47·2
Thur	9			1st Oc. D. ,, Ec. R.	12 25 15 49	7 43·2
Fri	10			2nd Ec. R. 1st Tr. I. ,, Sh. I. ,, Tr. E. ,, Sh. E.	9 40 56 9 43 10 54 11 58 13 9	7 39·3
Sat	11		Saturn's Ring: Major Axis = 35″·0 Minor Axis = 15″·2	1st Oc. D. ,, Ec. R.	6 53 10 18 14	7 35·4
Sun	12	3 0	☾ Moon's Last Quarter	1st Sh. I. ,, Tr. E. ,, Sh. E.	5 23 6 25 7 38	7 31·5
Mon	13			3rd Oc. D. ,, Oc. R. ,, Ec. D.	8 20 11 0 13 18 59	7 27·6
Tues	14	17 25 18 24	Occultation of B.A.C. 6161 Reappearance of ditto Illuminated portion of disk of Venus = 0·962 of Mars = 0·958			7 23·7
Wed	15	4 40	Conjunction of Moon and Saturn, 0° 36′ N.	2nd Tr. I. ,, Sh. I. ,, Tr. E.	12 20 14 45 14 59	7 19·8

DATE			Principal Occurrences	Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Thur	16		Sidereal Time at Mean Noon, 21h. 44m. 8·62	1st. Oc. D.	14 17	Jupiter — 7 16·0
Fri	17	1 20	Conjunction of Moon and Mercury, $1^{\circ} 35'$ N.	3rd Sh. E. 2nd Oc. D. 1st Tr. I. 2nd Ec. R. 1st Sh. I. „ Tr. E. „ Sh. E.	6 3 7 11 11 34 12 16 37 12 49 13 49 15 5	7 12·2
Sat	18		Meridian passage of the Sun, 14m. 10s. after Mean Noon	1st Oc. D. „ Ec. R.	8 45 12 14 1	7 8·4
Sun	19	1 48	● New Moon	1st Tr. I. 2nd Sh. E. 1st Sh. I. „ Tr. E. „ Sh. E.	6 2 6 46 7 17 8 17 9 33	7 4·6
Mon	20	9 40	Conjunction of Moon and Venus	1st Ec. R. 3rd Oc. D. „ Ec. R.	6 43 1 12 8 14 49	7 0·8
Tues	21					6 57·0
Wed	22			2nd Tr. I.	14 53	6 53·2
Thur	23					6 49·5
Fri	24			3rd Sh. I. 2nd Oc. D. 3rd Sh. E. 1st Tr. I. „ Sh. I. 2nd Ec. R.	7 18 9 42 10 5 13 27 14 44 14 52 15	6 45·7
Sat	25			1st Oc. D. „ Ec. R.	10 39 14 9 50	6 42·0
Sun	26	22 38 9 17 10 23	☽ Moon's First Quarter Occultation of B.A.C. 1272 Reappearance of ditto	2nd Sh. I. „ Tr. E. 1st Tr. I. „ Sh. I. 2nd Sh. E. 1st Tr. E. „ Sh. E.	6 42 6 49 7 55 9 13 9 24 10 10 11 28	6 38·3
Mon	27	15 33	Conjunction of Moon and Jupiter	1st Ec. R.	8 38 50	Moon — 6 15·5
Tues	28					7 3·3

THE PLANETS FOR FEBRUARY.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	19 22 52	−20 0½	8″·0	22 34·2
	15th	20 16 54	20 7	6″·3	22 33·0
Venus	1st	21 52 59	−14 27	10″·0	1 7·8
	15th	22 59 24	8 1	10″·3	1 19·0
Mars	1st	12 34 1	−0 8½	12″·5	15 46·4
	15th	12 34 22	+0 7	14″·1	14 51·7
Jupiter	1st	5 1 34	+22 26	41″·1	8 15·2
	15th	5 1 15	+22 28	39″·3	7 19·8
Uranus	2nd	7 43 18	+21 53	4″·2	10 52·4
	14th	7 41 13	+21 58	4″·2	10 3·3
Neptune	2nd	1 13 59	+6 2½	—	4 24·3

Mercury passes the meridian about an hour and a half before noon on the 1st, the interval decreasing to the end of the month. It may therefore be well seen in the morning at beginning of the month.

Venus passes the meridian on the 1st more than an hour after noon, and by the end of the month an hour and a half. It will therefore be visible just after sunset.

Mars passes the meridian on the 1st, three hours and three quarters after midnight, and will be visible earlier each night following to the end of the month.

Jupiter may be observed through the greater part of the night, setting at the end of the month at a little before three o'clock in the morning.

Uranus is well situated for observation.

MOON'S TERMINATOR.

Selenographic longitudes, at which the Moon's Terminator passes the Lunar Equator and the parallels of 60° of northern and southern latitude.

Greenwich midnight		60° N.		0°		60° S.
		Sun's Centre Rising:				
		°		°		°
1871. Feb. 1	...	−50·1	...	−51·6	...	−53·2
2	...	62·2	...	63·8	...	65·3
3	...	74·3	...	75·9	...	77·5
4	...	−86·4	...	−88·0	...	−79·7

SUN'S CENTRE SETTING:

5	+78·2	+79·8	+81·5
6	66·0	67·7	69·4
7	53·8	55·6	57·3
8	41·7	43·4	45·2
9	29·5	31·3	33·1
10	17·3	19·1	21·0
11	+5·1	+7·0	+8·8
12	−7·1	−5·2	−3·3
13	19·3	17·4	15·4
14	31·5	29·5	27·6
15	43·7	41·7	39·7
16	56·0	53·9	51·9
17	−68·2	−66·1	−64·1

SUN'S CENTRE RISING:

20	+79·4	+77·3	+75·1
21	67·3	65·1	62·9
22	55·1	52·9	50·7
23	43·0	40·7	38·4
24	30·8	28·5	26·2
25	18·6	16·3	14·0
26	+6·5	+4·1	+1·8
27	−5·7	−8·0	−10·4
28	−17·8	−20·2	−22·6

ALGOL.

According to Professor Schoenfeld's Ephemeris, in *Astr. Nachr.*, No. 1,807, Algol will be at its minimum—

	h.	m.	
1871. Feb. 2	7	28	G. M. T.
5	4	17	,,
13	18	45	,,
16	15	34	,,
19	12	23	,,
22	9	13	,,
25	6	2	,,

THE GREAT AURORA.—It is announced that the diggers at the diamond-fields on the Vaal, South Africa, witnessed a brilliant display of the Aurora Australis on the nights of the 23rd and 24th of October. It will be remembered that the Aurora Borealis was singularly splendid in this country at that period, the most extraordinary display on the 24th of October having been specially noticed in this paper for its unusual character. It is very interesting to have now this accidental record of the simultaneous intensity of this electrical phenomenon at both the northern and southern poles of our planet.

NEW VARIABLE STAR.—M. Krüger, writing from Helsingfors under date of Dec. 15, 1870, announces the discovery of a new variable star, which he designates T Cassiopeiæ. Its position (1855) is RA. 15m. 25s., and Decl. + 54° 59·3′. The changes of magnitude appear to range from 7½ to 9.

DOUBLE STARS.—Observers of double and binary stars may like to know that Baron Dembowski is publishing, in the *Astronomische Nachrichten*, a series of recent measures of Shure's doubles. These will be found in the following numbers of the periodical in question:—1798, 1799, 1800, 1806, 1808, 1810, 1822, 1823, 1826, 1829, and 1830.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN FEBRUARY 1871.

By W. R. Birt, F.R.A.S.

Day	Supplement ☾ − ☉ Midnight			Objects to be observed
	°	′		
1 ...	41	33	...	Sinus Iridum and region on the N.
2 ...	30	18	...	Mare Imbrium, its dark border on the N.W.*
3 ...	18	48	...	Pythagoras, Grimaldi Schickard.
4 ...	7	1	...	Objects between the M. Crisium and the W. Limb.
21 ...	150	37	...	Mare Crisium, craters and spots on its surface.
22 ...	139	0	...	Cleomedes, line of eruption in the interior.
23 ...	127	39	...	Atlas, Hercules, Guttemberg.
24 ...	116	33	...	Lacus Mortis, Plana, Burg.
25 ...	105	37	...	Aristoteles, Eudoxus, "Alexander." †
26 ...	94	48	...	Hipparchus,‡ Triesnecker, Hyginus.§
27 ...	83	58	...	Albategnius, Parrol, Airy.
28 ...	73	5	..	Clavius, Terra Photographica.¶

After the full, the objects specified in January may be observed under the reversed light in the order in which they are mentioned.

The lunar season is between the autumnal equinox and winter solstice, N. hemisphere N. pole in darkness.

* Consult Monthly Notices R. A. S. Vol. xxiii. p. 224.

† The formation betweeen Eudoxus and the Mare Serenitatis has been named "Alexander" from its resemblance in some measure to the formation S. of Menelaus known as "Julius Cæsar." The two formations are nearly on the same meridian.

‡ Consult Monogram of Hipparchus for objects in the interior.

§ The Dorpat drawing by Mädler, on a large scale, of the Godin and Agrippa region, including the clefts of Triesnecker and Hyginus, annexed to the revised edition of the large map, may be consulted with advantage.

¶ Named to commemorate Mr. De la Rue's labours in celestial photography. The formation is west of Clavius.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1870.

Dallmeyer, J. H.
Davies, Lieut.
Glaisher, James
Metcalf, Rev. W. R.
Petty, T.
Prince, C. L.
Reside, J.

To March 1871.

Hemming, Rev. B. F.
Jackson-Gwilt, Mrs.
Ormesher, H.
Rivaz, Miss
Ryle, Rev. J. C.
Woodman, T. C.
Wright, W. H.

To June 1871.

Fleming, Rev. D.
Hubbersty, R. C.
Rump, H. R.
Sargent, Rev. J. P.

To July 1871.

Green, S.

To December 1871.

Bird, F.
Collingwood, E.
Davies, Rev. R. B.
Escombe, R.
Jones, Rev. E.
Lamb, W.
Lee, J.
Monk, Dr.
Perry, Rev. J. S.
Prout, Rev. E.
Redpath, H. S.
Richard, J. E.
Slugg, J. T.
Thompson, Prof.
Tidmarsh, Rev. J. B.
Waldegrave, Hon. H. N.
Warinner, H.
Wilson, T.

January 24, 1871. Subscriptions after this date in our next.

NOTICES TO CORRESPONDENTS.

We are obliged to postpone Mr. Grover's Notes on the Starry Heavens, also a paper by Lieutenant Davies upon a Loss of Intensity of Light, &c.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House*, *Pembury Road*, *Clapton*, *N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 99. MARCH. 1871.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Fourth Meeting, February 10, 1871.

The Annual General Meeting.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last annual meeting were read and confirmed. The Report of the Council, including that of the auditors, was presented and read. The number of Fellows and Associates is 554. The accounts were satisfactory, and full details of the stock of publications and the instruments belonging to the Society were given.

Part II. of Volume XXXVII., and Volume XXXVIII. of the *Memoirs*, have been published. They contain the following papers.

Volume XXXVII., Part II. :—

1. "On a Determination of the Direction of the Meridian with a Russian Diagonal Transit Instrument." By Capt. A. R. Clarke, R.E., F.R.S.

2. "A Determination of the Constant of Nutation from the Observations in N.P.D. of *Polaris*, *Cephei* 51, and δ *Ursæ Minoris*, made with the Transit-circle of the Royal Observatory, Greenwich, 1851-65." With an Addendum containing "A Determination of the Constant of Nutation from the Observations of *Polaris* in Right Ascension." By E. J. Stone, Esq., M.A., F.R.S.

Volume XXXVIII. :—

1. "Seventh Catalogue of Double Stars, observed at Slough in the years 1823-28 inclusive, with the 20-feet Reflector; 84 of which have not been previously described." By Sir J. F. W. Herschel, Bart., F.R.S.

2. "On the Determination of the Orbit of a Planet from Three Observations." By Professor Cayley, F.R.S.

An Index to the first 29 volumes of the *Monthly Notices* has been compiled by Mr. Williams, at the desire of the Council, and

printed and presented to the Fellows of the Society. This is a most useful work.

The Society has to regret the loss by death of the following Fellows and Associates:—Fellows:—Prof. E. W. Brayley, Mr. C. Mason, Admiral Manners, Mr. H. Boys, Sir F. Pollock, Rev. Dr. Gwatkin, Mr. G. R. Smalley, Mr. J. G. Perry, Mr. C. D. Archibald, Mr. C. Frodsham, Colonel Sir W. T. Denison, Mr. H. Barrow. Associate:—Prof. H. Selander.

From the obituary notices we extract the following biography of the late President:—

Admiral Russell Henry Manners was born in London on the 31st of January 1800, entered the Royal Naval College the 6th of May 1813, and embarked March the 6th, 1816, as a volunteer on board the *Minden*, 74, Captain Paterson; in which, after assisting at the bombardment of Algiers, he proceeded to the East Indies, where he served under the flag of Sir Richard King, until nominated midshipman, the 1st of July 1818, to the *Orlando*, 36, commanded by Captain John Clavell, with whom, in 1819, he returned to England on the *Malabar*, 74. After an intermediate employment on the Channel and West India stations in the *Spartan* and *Pyramus* frigates, under Captains W. Furlong Wise and Francis Newcombe, he became, the 29th of July 1822, Acting Lieutenant of the *Tyne*, 26, Captain John Edward Walcot, to which vessel the Admiralty confirmed him the 19th of October following. In May 1823 he rejoined the *Pyramus*, still commanded by Captain Newcombe, under whom he continued until he obtained his promotion on the 16th of August 1825. His last appointment was on the 21st of October 1827, to the command of the *Britomart*, 10. The *Britomart* was first employed and intended for the Channel service under the order of the Commander-in-Chief, the Earl of Northesk, at Plymouth. She accompanied the squadron of ships escorting Don Miguel to Lisbon in the early part of 1828. In consequence of the revolution that followed in Portugal on Don Miguel declaring himself absolute, the *Britomart* was stationed at and off Oporto to watch the British interests there. The zeal and ability with which this service was carried out by Captain Manners, as witnessed by Sir George Sartorius, there in command of the Portuguese Constitutional Squadron, and under whose orders in some degree the *Britomart* was placed, led to Captain Manners receiving his Post-rank on the 4th of March 1829. He retired from active service in March 1849, became Rear-Admiral in July 1855, Vice-Admiral in April 1862, and Admiral in September 1865.

Admiral Manners was the only child of the late Mr. Russell Manners, M.P., and married, in 1834, Louisa Jane, daughter of Count de Noé, peer of France, who survives him, and by whom he has two sons and a daughter.

From the time he attained his Post-rank to the time of his death he devoted himself to scientific pursuits. He was elected a member of the Royal Astronomical Society in 1836. At a very early period he took an active interest in its administration, and, after being on the Council for some time, was elected one of the honorary secretaries in February 1848—an office which he filled until 1858, when he accepted that of Foreign Secretary. This was a post for which his knowledge of foreign languages and his position in society peculiarly fitted him; and during his tenure of office he formed, by active correspondence, a connecting link between English and foreign astronomers.

Admiral Manners was, on more than one occasion, asked to accept the chair of President, which, after some hesitation, he consented to do and

he was elected to that position in 1868. None of his predecessors were more highly esteemed by the Fellows of the Society, and no one filled the chair more admirably than he did. His mathematical attainments were considerable—more so than one might be apt to infer from his quiet demeanour. He was well versed in the astronomical literature of the day, and took a deep interest in the progress of astronomical science, both in England and on the Continent; and his active influence was always available for the promotion of any object connected with it.

On presenting the gold medal of the Society to Mr. Stone, first assistant of the Royal Observatory, Greenwich, Admiral Manners delivered a most able and exhaustive summary of that able astronomer's labours, and evinced a complete knowledge of the history of the solar parallax, for the investigation of which the medal was mainly awarded. Illness overtook him before he could complete his second year of office, and he was compelled to forego the gratification of delivering the address to M. Delaunay for his researches on the lunar theory; but he made it a point of duty and pleasure to receive M. Delaunay at his house; and although he was compelled to delegate to the friendly hand of Prof. Adams the drawing up of the address, yet he read and approved of what was written before it was delivered.

Admiral Manners, in all his relations, was a pure-minded, courteous, and sympathetic man, and in the fullest sense of the word a gentleman.

At the Royal Observatory, Greenwich, the usual work has been carried on. The Sun, Moon, and Planets have been observed with the Transit Circle, and the Moon with the Altazimuth. In consequence of the siege of Paris, the observations of the small planets had to be carried on during the whole lunation, instead of only half as usual. Observations of the Solar Eclipse of December 22 were made with the great Equatorial and Altazimuth, for correcting the tabular places and semi-diameters of the Sun and Moon, and ascertaining the amount of irradiation. A gradual subsidence of the eastern pier of the Transit Circle having taken place, a sheet of writing paper, $\frac{1}{270}$th of an inch thick, was placed under the Y, which produced the desired correction. The new 7-year Catalogue, 1861–1867, has been printed and distributed, and will be found of great value to astronomers.

At Cambridge the new Transit Circle due to the munificence of Miss Sheepshanks has been mounted, and is now undergoing examination and adjustment. The Radcliffe Observatory, Oxford, has lost a valuable assistant, Mr. Bechaux, by death. The volume of observations for 1867, including a catalogue of 1,772 stars, has been printed and published, and the heliometer has been provided with a solar eye-piece, in which the light is diminished by polarising prisms. At Stonyhurst, great improvements and additions have been made in the spectroscopic and meteorological departments. Double stars have been measured, the solar lines and prominences observed, and comets and meteors watched.

With respect to the general progress of Astronomy the Report remarks:—

The progress of Astronomy, in common with that of every other science, has been seriously affected by the terrible war, which has so largely absorbed the attention of all classes since July 1870. We have been influenced by it in England, but in France and Germany scientific progress has been greatly interrupted. Even before the completion, in September last, of the great cordon of troops and artillery which has shut off Paris from the rest of the world, the effects of war on science were shown by the reduced size of the *Comptes Rendus*, and the disappearance of some French scientific journals. In Germany, many young astronomers of great promise, not altogether unknown in this country, exchanged the observatory for the battle-field, where some, alas! have fallen.

But notwithstanding these unfavourable circumstances, the year just closed has not been barren of discoveries. Three planets, hitherto unrecognised, have been added to the known members of the solar system; four comets have been detected, some even in Germany at no great distance from the scene of war; and an increase to our knowledge of the constitution of the Sun has been undoubtedly obtained from the recent Solar Eclipse, to observe which, two of the greatest astronomical expeditions of modern times were organised and despatched from this country and America to Sicily, Cadiz, Gibraltar, and Oran. In our own Society the evening meetings have been well attended, at which important papers have been read and freely discussed.

The Report then details the fitting out and organisation of the Expeditions for observing the total Solar Eclipse of Dec. 22, 1870, and proceeds thus:—

The present time is too early for a complete analysis of the different observations with a view of eliciting from them the new teaching which they may contain of the extent and nature of the coronal light, still it may not be undesirable to give a short account of some of the more important observations.

In the last Annual Report, in the account of the Eclipse of August 1869, attention was called to the two apparently distinct portions besides the prominences in the light seen round the Moon during totality. The American pictures showed similar indications of brighter portions near the Sun's limb, within which the eruptions of hydrogen forming the prominences take place, to those which were visible in the photographs taken by Mr. De la Rue in 1860, and by Tennant and Vogel in 1868. A distinction between different portions of the coronal light was observed as early as 1706 by MM. Plantade and Capiés at Montpelier. "As soon as the Sun was eclipsed there appeared around the Moon a very white light forming a corona, the breadth of which was equal to about 3′. Within these limits the light was everywhere equally vivid, but beyond the exterior contour it was less intense and was seen to fade off gradually into the surrounding darkness, forming an annulus around the Moon of about 8′ in diameter." In 1842 M. Arago considered this distinction to be sufficiently marked to sanction the subdivision of the corona into two concentric zones, the inner zone equally bright and well defined at the outer border, while the exterior zone gradually diminished in brightness until it was lost in the surrounding darkness.

The observations of the eclipse of last December confirm these earlier descriptions as to the apparent subdivision of the coronal light, though the breadth of the inner zone varies considerably as described by different observers. In our future remarks we shall restrict the word *corona* to

the inner brighter ring, and for the faint exterior portion use the term *halo*.

It may conduce to clearness in our interpretation of those observations which appear to differ from each other, if we consider that the imperfect transparency of our atmosphere must cause a scattering of a portion of the light of the corona seen through it, and form a more or less brightly illuminated screen between the eye and the eclipsed sun. The atmospheric light will interfere especially with the observer's appreciation of the form and extent of the faint halo. There may exist at least three distinct sources of the light seen about the sun, in addition to the prominences, the corona, a solar halo overlapping the corona or beginning at its exterior limit, and an atmospheric halo produced by the scattering of the light by our atmosphere. The corona and solar halo would probably not alter greatly in the short time between observations of the same eclipse at different stations, but the scattering light would be peculiar to each station, and be mixed up with the effect of haze or light cloud present at the time. It is *possible* that without the earth's atmosphere some scattering of light may arise from the imperfect transparency of interplanetary space, not to speak of the possible existence of finely divided matter most densely aggregated around the sun. It may be that in these and some other considerations will be found the key to the interpretation of the widely different descriptions of the solar surroundings which come to us from different observers.

Prof. Watson, observing at Carlentini, describes a bright corona about 5′ high; observations at Cadiz give a breadth of about 3′; Lieut. Brown, observing with Lord Lindsay, found the inner zone, which he saw defined at its outer margin, to vary from 2′ to 5′ in breadth. Mr. Abbott, at Gibraltar, makes it about 5′ high. Some of the observers describe the exterior contour of the corona to be affected by the prominences, bulging out over the loftiest of these. In the photographs a defined corona is also seen,—in Lord Lindsay's photographs and the one taken by Mr. Willard, it extends rather more than 1′. In the photograph by Mr. Brothers the height of the brighter zone varies from 3′ to 5′.

We will now speak of the photographs of the totality, which are very instructive.

The photographs taken at Cadiz by Lord Lindsay were obtained by placing the sensitive surface at the focus of a silvered glass mirror 12¼ inches in diameter and 6 feet focal length, giving an image of the sun about ¾-inch in diameter. The other photograph taken near Cadiz by Mr. Willard of the American expedition was obtained at the focus of an achromatic object-glass of 6 inches diameter, specially corrected for actinic rays.

Mr. Brothers, at Syracuse, employed a photographic object-glass of 30-inches focal length and 4 inches diameter, lent to him by the maker, Mr. Dallmeyer. This lens gave a brilliant image of the sun about three-tenths of an inch in diameter, which was received upon a plate 5 inches square. The camera was mounted on the Sheepshanks equatorial, belonging to the Society.

The photograph taken at the commencement of totality by Lord Lindsay had an exposure of twenty seconds. It shows around the Moon's advancing limb a bright corona extending about 1′ from the Moon's limb, in which the prominences are distinctly marked. Outside this a halo of faint light diminishing rapidly in brilliancy with indications of a radial structure which can be traced as far as 15′ from the Moon's limb. On the other side of the Moon, where it overlaps the Sun sufficiently to conceal the prominences and the bright corona, *the halo is almost absent.* It may be suggested that such portion of the halo as appears around the advancing limb

of the Moon has its origin on this side of the Moon. As a pure speculation the explanation may perhaps be hazarded, that the true solar halo, as some spectroscopic observations would suggest, was less powerfully actinic than the scattered light of the prominences and corona, in which the halo on the one side of the Moon only as seen on the plate may have its origin.

The photograph taken by Mr. Willard was exposed during a minute and a half, and therefore must contain mixed up several successive appearances. The prominences are distinctly shown, and a defined corona of rather more than 1′ in height. In the halo there are indications of portions of unequal brightness, and a radial structure, but the most remarkable feature is a V-shaped rift or dark space, in the halo on the south-east, beginning from the outer boundary of the bright corona; a second similar dark space is faintly traceable on the south. The same dark gaps are also recorded in an eye-sketch by Lieut. Brown. Similar dark rifts are also shown in Mr. Brothers' photograph taken at Syracuse. The photograph taken by Mr. Brothers is very valuable, since it shows the halo extending towards the north-east, about two diameters of the Moon, and on the east and south about one diameter; the halo, therefore, is not concentric with either the Sun or Moon, but extends to the greatest distance in the direction from which the Moon is moving. It shows in many parts traces of a radial structure. The stronger light about the Moon is much broader on the west and north, and assumes a somewhat stellate appearance with rays gradually softening down as if combed out into the fainter halo. This photograph was taken in nine seconds, and therefore presents a true representation of the different phenomena at the time, that is, so far as their relative actinic power, which may possibly differ in a sensible degree from the relative brightness they present to the eye. The eye-sketches made at different stations show remarkable differences, especially in the form of the outer part of the halo: some represent it as consisting of separate rays, others give to it an almost true geometrical contour; in some of the Spanish sketches a tendency to assume roughly a quadrangular form can be detected, while in most of the Sicilian drawings there is a tendency to an annular form.

We pass to the spectroscopic results of the corona and halo.

Prof. Winlock, using a spectroscope of two prisms on a five and a half inch achromatic, found a faint continuous spectrum. Of the bright lines, the most persistent was 1474 Kirchhoff. This bright line, and the continuous spectrum without dark lines, were followed from the Sun to at least 20′ from his disc. Prof. Young estimates the least extension of this line to a solar radius.

Capt. Maclear, observing with a direct-vision spectroscope attached to a four-inch telescope, saw a faint continuous spectrum and bright lines in positions about C D E and F to a distance of 8′ from the Moon's limb, and also the same lines, but much fainter, *on the Moon's disc.* This observation would seem to show, as has been already suggested, that some of the light from the true surroundings of the Sun is scattered by some medium between the eye and the Moon, and therefore the distance from the Moon to which these lines can be traced does not imply necessarily an equally great extension of the true halo.

Lieut. Brown, of Lord Lindsay's party, saw only a continuous spectrum without bright lines. Mr. Carpmael, observing at Estepona, saw three bright lines in the spectrum of the corona. He considers the one in the green to correspond with 1359 Kirchhoff.

The observations with the polariscope show that a portion of the coronal light is polarised; and though the results as to the plane of polarisation

are interpreted differently by different observers, there seems reason to suppose with Mr. Ranyard that the light is polarised radially, showing that the corona and halo may possibly reflect solar light as well as emit light of their own.

There is one observation made by Prof. Young which is of so much importance that it will be well to give an account of it in Prof. Langley's words :—

"With the slit of his spectroscope placed longitudinally at the moment of obscuration, and for one or two seconds later, the field of the instrument was filled with bright lines. As far as could be judged, during this brief interval every non-atmospheric line of the solar spectrum showed bright; an interesting observation confirmed by Mr. Pye, a young gentleman whose voluntary aid proved of much service. From the concurrence of these independent observations we seem to be justified in assuming the probable existence of an envelope surrounding the photosphere, and beneath the chromosphere, usually so called, whose thickness must be limited to two or three seconds of arc, and which gives a discontinuous spectrum consisting of all, or nearly all, the Fraunhofer lines showing them, that is, *bright* on a dark ground."

Rapid and imperfect as this early sketch must necessarily be of the observations of the last eclipse, it shows a distinct and important gain to our knowledge of solar physics.

Some extremely valuable results, due to the researches of Physicists in Spectrum Analysis, are then adverted to :—

In the winter 1867–8 Angström found the light of the auroral arc to be nearly monochromatic, giving in its spectrum a single brilliant line in the green near the group of calcium lines, and traces of three feeble bands near F. This observation was confirmed by Struve. In 1869 Professor Winlock observed five bright lines in the green and blue parts of the auroral spectrum.

During the past year a brilliant line in the red portion of the spectrum has been detected in some parts of the auroral display. This line was observed first by Mr. Ellery, at Melbourne, on April 5, 1870.

On October 25 Zöllner compared the position of the red line with the lines of lithium and sodium. From the position of the auroral lines relatively to these, he considers that it falls in the spectrum very nearly where a group of atmospheric lines occurs in the solar spectrum, having a mean wave-length of 0·0006279. Zöllner suggests that this auroral spectrum, which does not correspond with any known spectrum of the gases of the atmosphere, may be a spectrum of one or more of these gases of an order we have not yet been able to obtain experimentally, since we can only have to do with thin strata of gas, whereas the auroral light may come from an enormously thick layer of one or more of the gases of the atmosphere at a relatively low temperature.

Mr. Lockyer, in continuation of his important researches on Solar Physics, considers that he has now evidence, from the different behaviour of the line C and the line near D, that the latter does not belong to hydrogen—a result in harmony with the absence of the line near D, from the different spectra of hydrogen obtained experimentally.

His observations show, he believes, that prominences may be divided into two classes—those in which great action is going on and lower vapours injected, and those which are tranquil so far as wave-length goes, which are usually high, bright, and persistent.

While observing a solar spot with the spectroscope, on April 16, Mr.

Lockyer saw "the whole prominence spectrum was built up of single discharges shot out from the region near the limb, with a velocity sometimes amounting to a hundred miles in a second. On the following day, using a tangential slit, he found in the spectrum of the base of the prominence hundreds of the Fraunhofer lines beautifully bright." Mr. Lockyer considers that he has evidence that at the present maximum period of sun-spots not only is the region of a spot comprised by the penumbra, but the chromosphere also is shallower than in the year 1868.

Prof. C. A. Young has succeeded, by means of a spectroscope having a dispersive power of thirteen prisms of heavy flint each with an angle of 55°, attached to an achromatic telescope of 6·4-inches aperture, and 9 feet focal length, in obtaining photographs of the solar prominences. Negatives have been made which show clearly the presence and general form of the protuberances, but at present the definition of details is unsatisfactory. The hydrogen line γ (2,796 of Kirchhoff), though very faint to the eye, was found to be decidedly superior to F in actinic power.

Professor Respighi has done good service in the same field of research by mapping all the prominences which appear around the sun from day to day, and arranging them for each day in a straight line, so that the appearances for different days by being placed under each other admit of easy comparison.

Valuable additions have been made during the past year to the apparatus employed in spectroscopic research. The most important of these, doubtless, are improved methods by which the prisms of a spectroscope can be brought automatically to the position of minimum deviation for any part of the spectrum to which the observing telescope is directed.

Independent methods by which this important addition to the spectroscope has been successfully accomplished are described by Mr. Browning and Mr. Grubb, and valuable suggestions contained in a paper by Mr. Proctor. Ingenious apparatus for recording the lines seen have also been devised.

Three minor planets have been discovered within the last twelve months, *Lydia* (110) at Marseilles, by M. Borelly, on April 19; *Ate* (111) at Hamilton College, Clinton, New York, by Dr. C. H. F. Peters, on August 14; and *Iphigenia* (112) also by Dr. C. H. F. Peters, on September 19.

The following comets have been under observation since the date of the last Report. Three of them were detected by Dr. Winnecke. Comet I. 1870, discovered by Dr. Winnecke, at Carlsruhe, on May 29; Comet II. 1870, discovered by M. Coggia, at Marseilles, on August 28; Comet III. 1870 (Periodic Comet of D'Arrest), detected by Dr. Winnecke, on August 31; Comet IV. 1870, discovered by Dr. Winnecke, on November 23.

The Report then proceeds to give interesting notices of the new Zenith Sector, for the Indian Survey, constructed from the design of Colonel Strange, and most favourably reported on by Captain Herschel. It commends Professor Cayley's paper on the Graphical Construction of a Solar Eclipse, and Mr. Proctor's excellent Star Atlas, and his papers on the Distribution and

Distances of the Fixed Stars. The report narrates Dr. Brünnow's observations at Dunsink, Ireland, with the great *South* refractor, especially his researches on the parallax of α Lyræ and 61 σ Draconis, the former star giving $0''\cdot214$, and the latter $0''\cdot255$; and concludes with an account of Lord Rosse's further experiments on the heat of the Moon, and Mr. Browning's description of changes of colour on the belts of Jupiter.

The President's Address.

Mr. Lassell stated that no medal had been awarded this year, but that it must not be inferred from this that there were no astronomers worthy of such a reward, but rather the reverse. The fact was, that recently one science had become so dependent on others that it frequently happened two or more persons were associated in their researches, and it became difficult to apportion their share in the results, or to give a medal to one without doing injustice to the other. A double medal had been suggested as the remedy, but as the bye-laws appeared to prohibit this, it might be worth while to consider the propriety of altering them in this respect. The President also said that as the number of the satellites of Uranus still seemed doubtful, he would suggest the devotion of some large telescope, and the time and labour of an observer, to clear up the matter. The delay in the completion of Mr. Newall's telescope, which was peculiarly fitted for such work, was much to be regretted, but as the position of the planet was very favourable, though now declining in altitude, he hoped the subject would not be lost sight of.

It was moved by Lord Lindsay, and seconded by Admiral Ommaney, and resolved—

That the Report and President's Address be received, printed, and circulated in the usual manner.

An additional 100 copies were ordered to be printed on account of the interest taken in the Eclipse Expeditions, to supply the observers and others not Fellows of the Society.

W. C. Russell, Esq. and T. Elgar, Esq. were balloted for and duly elected Fellows of the Society.

Major-General Boileau, Captain Parsons, and Mr. Carpenter having been appointed Scrutineers, the ballot for the election of Officers took place. The following were chosen:—

President:

William Lassell, Esq., F.R.S.

Vice-Presidents:

J. C. Adams, Esq., M.A., F.R.S., *Lowndean Professor of Astronomy, Cambridge.*

G. B. Airy, Esq., M.A., F.R.S., *Astronomer-Royal.*
A. Cayley, Esq., M.A., F.R.S., *Sadlerian Professor of Geometry, Cambridge.*
Rev. Robert Main, M.A., F.R.S., *Radcliffe Observer.*

Treasurer:

Samuel Charles Whitbread, Esq., F.R.S.

Secretaries:

Edwin Dunkin, Esq.
William Huggins, Esq., F.R.S., D.C.L., LL.D.

Foreign Secretary:

Lieut.-Col. Alexander Strange, F.R.S.

Council:

John Browning, Esq.
J. Buckingham, Esq.
Thos. W. Burr, Esq.
Warren De La Rue, Esq., D.C.L., F.R.S.
E. B. Denison, Esq.
George Knott, Esq.
J. Norman Lockyer, Esq., F.R.S.
Captain William Noble.
F. C. Penrose, Esq.
Rev. Charles Pritchard, M.A., F.R.S., *Savilian Professor of Astronomy, Oxford.*
R. A. Proctor, Esq., B.A.
Balfour Stewart, Esq., M.A., LL.D., F.R.S.

Upon the motion of Mr. C. V. Walker, seconded by Mr. Birt, the thanks of the meeting were voted to the retiring officers, and the Society adjourned.

We have received Mr. Burt's report of the Lunar Map and Catalogue, up to Dec. 31, 1870.

SOLAR ECLIPSE.—Mr. A. Brothers, of the Syracusan Exhibition, was successful in taking no less than five photographs during the totality. The last of his photographs is considered to be of great value and importance.

MR. NEWALL'S GREAT 25-INCH REFRACTOR.—In answer to enquiries, Mr. Newall informs us that the mounting of the great refractor is not yet finished. The chief parts were sent to him nearly a twelvemonth ago. The telescope was erected in March; in August the eye-end arrived, but it is still incomplete, requiring focussing adjustment. Illumination, micrometer, and divided circles are also desiderated. We trust that before long we shall hear of the entire completion of this very important instrument, and thus that no more time than is absolutely necessary will be expended. It will be a great pity that science should longer be deprived of the fruits of this great undertaking, if it can be avoided.

MR. GRUBB AND THE GREAT MELBOURNE TELESCOPE.—Mr. Grubb, in a pamphlet, dated Dublin, March 23, 1870, denies all the charges brought

against the great telescope. He examines and answers all the objections in order. "So far as the piers of the instrument are concerned, there has been a double mistake at Melbourne, viz.: first, the allowing of a tracing sent under the caution, that it should not be *used further than for the foundation of the piers*, to get into Mr. Le Sueur's hands without that caution being affixed; and secondly, the mistake of Mr. Le Sueur in using that tracing instead of the true one, with which he was well acquainted here." In this tracing it apapears the clock hole was 3 feet wide by 4 feet high, instead of 2 feet 8 in. by 1 foot 11 in. The defects noticed in speculum A, he affirms to arise from the improper way in which the shellac coating was removed; first, that the shellac had not been entirely removed; secondly, that the surface was sticky in parts; thirdly, that methylated spirits had been used instead of alcohol. He also reprobates the use of water in the cleaning process. "There is," says he, "abundant evidence that speculum A has become unfitted for present use solely *from injudicious treatment at Melbourne.*" He goes into all the other objections which have been made. We would gladly give more detail if we had space.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE LATE SOLAR ECLIPSE.

Sir,—I had forwarded my telescope to Gibraltar, intending to proceed thither from Malaga on the 21st December, but from the delays so incidental to travelling in Spain I was unable to do so, and could only observe the eclipse from the latter city with no other aid than that of a small pocket glass and power of 15.

As the weather, however, was somewhat more favourable at Malaga than at most of the selected stations, a few details of what was seen there may not be without interest by way of comparison with observations made elsewhere, and with better appliances.

In order not only to see what might be possible of the eclipse itself, but also its effects upon terrestrial objects to the greatest advantage, I selected for my station the old Moorish castle, which commands a fine view of the city immediately below it, the beautiful plain with its surrounding mountains, and the bay over which the sun was.

The sky on the forenoon of the 22nd was covered with an upper stratum of thin fleecy clouds, while lower, large heavy masses, moving rapidly, threatened to hide the sun altogether, and after the first contact it was only visible at intervals till about 11.30, when they became nearly stationary, and observing a respectful distance from the great luminary, allowed us to witness the eclipse till the totality. As this drew nigh the great diminution of light was very striking, and just before it the shadow of the moon was seen advancing from the north-west, deepening the gloom in which the distant mountains were already enveloped into darkness.

With the glass the small portion of the disc still uncovered appeared both shorter and wider than I expected, and was more like the segment

made by the projection of a large circle upon a smaller, and the final extinction of the light immediately after seemed to me more rapid and sudden than in the eclipse of 1851.

The disappearance was no sooner complete than I perceived on the moon's western limb a beautiful and very delicate semicircle of a pale red tint, and the corona was instantly formed all round. Its general breadth was about one-fourth of the moon's diameter, but some of the rays were obviously longer, and three in particular very much so, one of these being about 20° to the west of the vertex, another 40°, and the third 100° to the east of the same point; and with the glass I perceived in the first and third a small conical-shaped light of a whiter colour, projecting about 2′ from the moon's limb.

To myself and three other observers the colour of the corona was pale red, but a fourth spectator thought it bluish-green; it was, however, decidedly different from the bluish-white tint of that I saw in 1851. Instantly on the sun's disappearance Venus flashed out, and from her proximity to it added very much to the effect. One star likewise was visible through an opening to the N.N.E., but the place of Mercury was covered by clouds, and I could discern nothing of Saturn with my small glass.

Turning to the landscape below, the scene was very grand and solemn, although the obscuration was certainly less than I observed at Helsingborg and Orduna, while the darkened sun with its lurid crown was indeed a "sign in heaven," inducing feelings of awe and reverence.

The sea horizon about 20° both east and west of the sun, but not below it, was of a fine yellow sunset colour. This struck me as singular, for the same phenomenon at Orduna in 1860 appeared on the horizon *opposite* to the sun, on the outer side of the shadow, and although at Helsingborg, in 1851, the greenish and reddish tints were then below the sun, we were very much nearer that side of the shadow; but in the present instance we were looking across three-fourths of it to the south, while no colour whatever was visible to the north, on which side the edge of the shadow was not above 20 miles distant.

I had no opportunity of noticing what effects the eclipse produced upon animals, &c. These were probably, from the state of the weather, less marked than on former occasions; but at the moment of totality a universal exclamation burst forth from the city below us, but whether of surprise and wonder, or of fear, as it was at Orduna, I cannot say.

Of a very good case of meteorological instruments I could make no use, further than to note that the temperature fell from 60° to 55°. The wind also increased in strength to the middle of the eclipse, and fell again after it.

I am, Sir, your obedient servant,

Ealing: Feb. 13, 1871. WM. L. BANKS.

AURORA BOREALIS.

Sir,—The brightest Aurora that I ever saw in this country was observed here on the night of the 12th inst. Its characteristics consisted of broad, comparatively steady, areas of white, and greenish-white light. There were but few moving beams or coruscations. Red light sometimes appeared for brief periods in one or two places. At 9h. 42m. G.M.T., a broad ill-defined arch to the south passed over Sirius and under Regulus, crossing the equator, east of the meridian, at an angle of about 27°, about the same as the magnetic variation here. At this time there was a corona formed

above Castor, perpendicular to the arch at the point of intersection. The display now seemed to forsake the northern parts of the sky, while the south, down to an inconsiderable altitude, and the east, and the west, were brightly illuminated. Orion was in a flood of light, and continued so for hours.

In the spectroscope only the strong green line appeared, but this with unusual brilliancy. It was given by the sky all round, and even by the earth. In the reflected light from the ground at my feet it was quite discernible.

The Aurora had but little declined at 2 o'clock, when I gave up observing.

J. BIRMINGHAM.

Millbrook, Tuam: Feb. 15, 1871.

CHANGES ON JUPITER.

Sir,—I beg to send you a few notes made during the months of December 1870 and January 1871, and also a few sketches.

Persistency of Band No. 2.—As Mr. Birmingham truly remarks, this very fine streak has been remarkable for its persistency. Very little change was detected here during the whole of the last apparition, while the changes in the southern hemisphere were exceedingly remarkable. Since the reappearance of the planet, however, well-marked changes have been noticed and confirmed night after night. These may be thus enumerated: first, the appearance of three dark protuberances on the southern edge of the band; second, one or two dark spots have been seen on the northern edge; third, the entire band has been seen very faint, but still broad as usual; fourth, the northern edge has been seen dark and sharp, while the southern edge remained faintly defined; fifth, its width varies slightly in different parts, the average being $2'' \pm$. The distance of this band from the one to the south (No. 3) still remains about $4''$.

Nos. 5 and 6 are, as during the last apparition, very interesting objects, whether we regard the curious forms seen on or near them, or the changes they have undergone and are still undergoing. It was in the bright zone between these streaks that the fine oval of 1869–70 was seen so long. On the south edge of No. 5 a curious square form, as dark, nearly, as the belt, was seen some months ago, and up to December 1870 presented a fairly uniform appearance. During January 1871, however, it was often seen, but was much less sharply defined and more diffuse. It was also followed by two dark protuberances, while occasionally, under good atmospheric conditions, three dark forms were seen.

No. 5 may often be seen nearly as broad and dark as No. 2. To the south of No. 5 may sometimes be seen two narrow bands; and, calling the northern one No. 6, it may be described as a rather dark band, half the width of No. 5, and as far south of No. 5 as that band is south of No. 4. Calling the most southern band No. 7, it may be described as narrower than No. 6, and as far south of No. 6 as that band is south of No. 5. To the south of No. 7 is seen the dusky band-like north boundary of the shade about the southern pole. Such was the appearance of this region at 9 P.M. January 26th, 1871.

The central zone presents less of character than during 1869–70. The festoons are usually, perhaps always, seen when the air is good; but the dark mottled character of the zone is less notable than it was. Occasionally dark streaks are seen in it, and they are parallel to the belts.

As seen in Mr. Crossley's large refractor, the colour of this zone is very slight indeed.

No. 1 has become broader since 1869.

No small bright spots have lately been seen on the disc.

I am, Sir, yours very truly,
JOSEPH GLEDHILL, F.G.S., F.M.S.

Mr. E. Crossley's Observatory,
Park Road, Halifax:
Feb. 3rd, 1871.

ON THE EVANESCENT NATURE OF THE BELTS OF JUPITER.

Sir,—On the evening of Wednesday last, the 8th inst., between 8 and 9 P.M., I was examining Jupiter, in company with a friend, with an 8-in. O. G., when we were rather surprised to see a well-defined dark belt unusually near the north pole of the planet, and after looking at other objects for some time, we again turned the telescope upon Jupiter, and found the same belt still there; but on looking for it again in about 20 minutes, we found to our surprise that the polar belt had entirely disappeared, no trace of it being left. No apparent change had taken place in the other belts, which were very clearly defined, particularly those north and south of the equator.

The above seems a corroboration of a similar thing seen by Sir William Herschel, and I have thought that an account of it may possess some interest.

I am, Sir, your obedient servant,
S. ADAMS.

Yew Tree Road, Edgbaston:
Feb. 13, 1871.

SUPPOSED CHANGES IN CELESTIAL BODIES.

Sir,—I was lately struck with a remarkable instance of how little some of our popular lecturers keep themselves up with the actual state of astronomy, even in regard to facts to which they appeal. I happened to hear a lecture by Dr. Cumming, the other day, in my own neighbourhood, in which he stated that "signs in the Sun and *in the Moon*" had been witnessed lately; and in support of the latter assertion, appealed to changes which had been observed in the lunar crater Linnœus.

By a rather amusing coincidence, I received about the same time a letter from my friend Mr. Birmingham, of Tuam, in which occurs the following passage:—"I had a peep at our old friend Linné the other night, and on the terminator for the second time in my life, and found it a small crater with the edge higher in the west than in the east. I do not believe there has been any change whatever."

I need scarcely remark, that this statement of Mr. Birmingham's is confirmatory of the conclusion which astronomers generally have for some time accepted. I omit all reference to the erroneous view of the nature of the supposed alteration in the appearance of the crater, in imagining that the discovery would have implied any *new* amount of activity on the surface of our satellite, and remain

Yours faithfully,
W. T. LYNN.

Blackheath: Feb. 14, 1871.

PROPOSED OBSERVATIONS OF VENUS.

Observing Astronomical Society.

Sir,—The committee of the above Society have decided to undertake a series of systematic observations of the planet Venus during one complete revolution, for the purpose of obtaining results that shall lead to our becoming better acquainted with the markings which are visible on her surface, and a correct knowledge of their forms and permanency.

In common with all other observers, it has been a matter of regret to them that although this beautiful object approaches nearer to us than any other member of the solar system (our satellite excepted), yet that our knowledge of its superficial condition should be far less than of those planets less favourably situate. In most astronomical works the information concerning Venus is very meagre, whilst the drawings of its appearance exhibit, in the majority of cases, merely a blank crescent.

Yet in turning to the ancient observations made of this planet, the committee have been struck by the large number recorded, many exhibiting well-defined markings, and when they consider the numerous observations of the same character made of late years, including several important ones by members of the Society, it seems evident that the satisfactory examination of this planet is not so difficult as is generally represented. It was seen further, that if a proper discussion and analysis of all recorded observations were made, the result might be a large addition to our knowledge of the planet's surface.

The committee, therefore, in inaugurating this most important movement, divide the work to be done into three branches:—

I. The formation of a sub-committee of astronomical observers (including non-members of the Society) for the purpose of continually observing Venus during one complete synodical revolution.

II. The collection of as many ancient observations and drawings of the planet as possible.

III. The collection of modern data from existing observatories, and from public and private records.

At the conclusion of the observations of the sub-committee, the results obtained, together with the ancient and modern observations collected, will be placed in the hands of a competent astronomer for complete analysis and discussion, when the results obtained will be published.

Those observers who are willing to join the "Venus Observation sub-committee" are requested to communicate their names and addresses to the Hon. Secretary of the Society, before March 10, stating the aperture and power of the instrument they intend to employ.

The observations will commence on March 20, previous to which a circular, containing full instructions, will be issued to every observer who has expressed his willingness to assist in the project.

I am, sir, truly yours,

WILLIAM F. DENNING,

Hon. Sec. Observing Astronomical Society.

Ashley Road, Bristol:
Feb. 15th, 1871.

*** In reference to the above undertaking, the Rev. T. W. Webb says:—"As regards the planet Venus, I enter fully into your idea. That beautiful planet has never received due attention, and the O. A. S. would do excellent service in accumulating materials for a thorough investigation of its surface."

THE SUPPOSED NEW PLANET VULCAN.

Sir,—During the period from March 20 to April 10 it is intended to make another systematic series of observations of the sun, with the object of detecting the suspected intra-Mercurial planet Vulcan in transit, and I shall be glad to hear from any of your readers who may feel desirous of rendering their assistance. If the weather is sufficiently favourable, each person will observe the solar disc during a certain time on every day throughout the above period, and it is to be hoped that by these means the sun will be kept under continual examination.

I am, Sir, truly yours,
WILLIAM F. DENNING,
Hon. Sec. O. A. S.

Bristol: February 15, 1871.

MOCK MOONS.

Sir,—My namesake has been the fortunate spectator of an unusually perfect display of a somewhat rare phenomenon, which however, I suspect, if it were carefully looked for, would be found of more frequent occurrence than may have been supposed. The colour not being so conspicuous as that of the parhelion, it may easily escape notice among clouds of a somewhat similar aspect. There are, however, unquestionably seasons of long duration—possibly of periodical recurrence—during which these appearances, whether connected with sun or moon, are extremely uncommon. I have formerly recorded paraselenæ on several occasions, but not for some years past. They have been referred to, I find, by Pliny, Eutropius, Hevel, and in our own country by the astrologer Lilly; and a fuller search would no doubt bring many more instances to light. A mock moon and several other singular appearances are described in *Nature* 26 January 1871 (the lower wood-cut, by the way, has evidently been inverted by the printer). A season of frequency may possibly now have commenced, and many of your readers may be interested in keeping watch for both solar and lunar appendages of this nature.

T. W. WEBB.

Hardwick Parsonage: Feb. 1871.

Sir,—J. Webb will find an account of mock moons seen in England in Symons's *Meteorological Magazine* for November 1869. I have seen mock moons here on six nights during the last six years, but perhaps they are rarer in the south.

Sunderland: 10th Feb. 1871. T. W. BACKHOUSE.

Sir,—J. Webb will find an account of paraselenæ seen in this country, as well as in others, in Thomson's *Meteorology*, pp. 242–244. On the theory of those appearances (that of parhelia and paraselenæ being similar) information is found in Loomis's *Treatise on Meteorology*, pp. 216–222; also in Kaemtz's *Meteorology*, pp. 426–440 (English translation). A drawing of a remarkable paraselene, seen in 1853 at Stone, is given in *Speculum Hartwellianum*, p. 389.

G. J. W.

CRATER CHAINS NEAR BULLIALDUS.

Sir,—The singular crater chains of Copernicus are well known to most lunar observers, and their striking appearance just after sunrise has been the subject of frequent study; but I should wish to bring into notice the existence of another group of crater chains which, though not so conspicuous as that near the giant Copernicus, is yet deserving of attention.

The region to which I allude lies to the south-west of Bullialdus; here, on the night of July 7th, 1870, using a power of 208 on my 6⅓″ Browning, with reflector, I found the hill γ of B. and M. was very clearly to be identified, and the outline of the broken-down crater ring, of which it forms a portion, could be well traced: but my attention was at once drawn to the region lying between γ and β; here, stretching away from the ring of which γ forms a portion, I saw several crater chains, the individual craters being smaller than those near Copernicus, but yet clearly possessing the same characteristics; one stream of craters at a little distance from γ, was noted as crossing another stream at right angles; the south-west slope of Bullialdus I found to be roughened with innumerable minute hillocks streaming far out into the surrounding plain, with numerous crater rows amongst them.

On referring to Beer and Mädler's map, I found that not a trace of this wonderful region, second only to that of Copernicus, is indicated, and my object in drawing the attention of the readers of the *Astronomical Register* to the subject is to ascertain whether these craters have been formerly observed, as I have been unable as yet to find any notice of them. Could we be sure that B. and M.'s delineation accurately represents the appearance of the district at the epoch of their map, we might then fairly point to this case as indicative of recent eruptive action.

It then becomes of interest to ascertain whether these craters have been before noticed, when they were first seen, or whether any observer is able to supply corroborative evidence that the region has been formerly observed as B. and M. have drawn it.

H. MICHELL WHITLEY.

Penarth, Truro: Feb. 10, 1871.

A BRILLIANT METEOR.

Sir,—Yesterday evening about ten minutes past nine, while walking along a road, I was suddenly startled by a flash of pale-coloured violet light, so intense and vivid, that the trees, hedges, a wall, and the very ruts in the road were distinctly visible for half a mile in front. Thinking it was lightning, I expected that the next moment I should be plunged in darkness, but to my surprise the light continued, and even grew more vivid. It cast my shadow in front; and in wonder, half expecting to see a sun, I turned, and as I turned could see the fields and hedges on my right for nearly a mile, and a wood at the end as plainly as in daylight. Then looking up, I saw a meteor darting towards the west. It disappeared almost the moment I saw it, but the trail remained for nearly two minutes. It was at first nearly straight, but gradually curled up at the ends, grew broader in the middle, and finally seemed to become so diffused in the atmosphere as to disappear. It appeared to be about two degrees to the west of the lower part of Orion. I have seen almost all astronomical and meteorological phenomena, but never observed so intense a light emitted by a meteor. It somewhat resembled the effect produced by the coloured

rockets at the Crystal Palace *fêtes*. I fancied I heard a hissing noise whilst the light continued, but this I consider a delusion, having frequently believed I heard crackling sounds during an aurora, which sounds science disbelieves. I put the phenomena down to what I may, perhaps, call homology of the senses, for I notice, if I touch brass and see it, I feel a disagreeable taste in my mouth. Why not, then, upon seeing particular kinds of light, should I not hear, or fancy I hear, sounds?—people sometimes imagine their names are called when no one speaks, as if there were memory of the ear. Now a quick flashing light carries the idea of crackling; the quick passage of a body that of hissing, as a bullet—thus, may not the senses be excited one by the other?

Whilst writing, I would wish to make a remark upon another subject. I see that attention has been recently called to the question as to whether or no the sun's rays, after passing through a vacuum, possess any heating power, it being still alleged that the rays, concentrated by a lens, will not melt ice in a vacuum. That some decrease of heat does accompany vacuum I imagine to be a fact, since at the summit of mountains, where the air is very rarefied, and so approaches to a partial vacuum, the rays of the sun produce scarcely any heat at all. This has been attributed to the absence of radiation, but I question if this completely accounts for the phenomena. If all mountain tops were mere points it might be so, but many mountain ranges are surmounted by table-land of vast extent, yet here the atmosphere is colder than on plains on a level with the sea, though the radiation must be the same. Possibly when atoms of air are wider apart, when air is rarefied in partial vacuum, the heat may pass as it were through, whereas, when the atoms are closer together, they are arrested. If it should be demonstrated that the sun's rays upon passing through a vacuum are shorn of heat, I think an aid will be gained towards the examination of the sun. It has hitherto been found necessary, has it not, upon looking at the sun through a telescope, to employ blackened or coloured glass to protect the eye from the intense heat and glare? Might not a vacuum be substituted for this coloured glass, allowing of a perfectly unobstructed view? If heat only was arrested, and the glare remained, possibly some means might be contrived to diminish the aperture, or shroud the eye, examining a small part of the disc only at one time.

Yours, very respectfully,

RICHARD JEFFERIES.

Coate, Swindon, Wilts.

To the Editor of the *Standard*.

Sir,—Last evening, while walking, at about 9.13 P.M., a light appeared suddenly in the heavens, and, on looking up, I saw a very large and brilliant meteor, in an N.E. direction, which slowly described an arc of a circle terminating in the S.W., leaving in its track a long streak of fire of different colours, which remained stationary for several seconds, and then gradually faded from view. Perhaps some of your numerous scientific readers may furnish you with a better description of this striking phenomenon.

I am, yours, &c.,

JAMES BLAKE.

Dockyard, Portsmouth: Feb. 14.

OBSERVATIONS FOR MARCH 1871.*

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator and of 60° of northern and southern selenographic lat., where the sun's centre rises or sets.

Greenwich midnight		60° N.		0°		60° S.
		SUNRISE:				
		°		°		°
1871. March 1	...	−30·0	...	−32·4	...	−34·8
2	...	42·1	...	44·5	...	46·9
3	...	54·2	...	56·7	...	59·1
4	...	66·4	...	68·8	...	71·3
5	...	−78·5	...	−81·0	...	−83·4
		SUNSET:				
7	...	+72·2	...	+74·7	...	+77·3
8	...	60·1	...	62·6	...	65·1
9	...	47·9	...	50·4	...	53·0
10	...	35·7	...	38·3	...	40·8
11	...	23·6	...	26·1	...	28·7
12	...	+11·4	...	+14·0	...	+16·5
13	...	− 0·8	...	+ 1·8	...	4·4
14	...	−13·0	...	−10·4	...	− 7·8
15	...	25·2	...	22·6	...	20·0
16	...	−37·4	...	−34·8	...	−32·2
17	...	49·6	...	47·0	...	44·4
18	...	61·8	...	59·2	...	56·6
19	...	−74·1	...	−71·4	...	−68·8
		SUNRISE:				
21	...	+86·8	...	+84·2	...	+81·5
22	...	74·6	...	71·9	...	69·3
23	...	62·4	...	59·7	...	57·1
24	...	50·2	...	47·5	...	44·9
25	...	38·0	...	35·3	...	32·7
26	...	25·8	...	23·1	...	20·5
27	...	+13·6	...	+10·9	...	+ 8·3
28	...	+ 1·4	...	− 1·3	...	− 3·9
29	...	−10·8	...	−13·5	...	−16·1
30	...	−23·0	...	−25·6	...	−28·3
31	...	−35·2	...	−37·8	...	−40·5 (M.)

* We feel sure that our readers will be obliged to our correspondent M. for these valuable communications.

MARS.

Areographic longitude and latitude of apparent centre of disk, angle of position of axis, and diameter.

1871 G. M. T.		Longitude 8h.	10h.	12h.	14h.		Lat. 12h.		Axis 12h.		Diam. 12h.
March 1	...	164°	194°	223°	252°	...	24·0° N.	...	31·7°	...	13·24°
2	...	156	185	214	243	...	24·0	...	31·5	...	13·33
3	...	147	176	205	235	...	24·1	...	31·4	...	13·41
4	...	138	167	197	226	..	24·1	...	31·2	...	13·49
5	...	129	158	188	217	...	24·2	...	31·1	...	13·57
6	...	120	150	179	208	...	24·2	...	30·9	...	13·64
7	...	112	141	170	200	...	24·2	...	30·8	...	13·71
8	...	103	132	162	191	...	24·2	...	30·6	...	13·78
9	...	94	124	153	182	...	24·3	...	30·5	...	13·85
10	...	85	115	144	173	...	24·4	...	30·3	...	13·91
11	...	77	106	135	165	...	24·4	...	30·1	...	13·96

1871 G. M. T.		Longitude 8h.	10h.	12h.	14h.		Lat. 12h.		Axis 12h.		Diam. 12h.
March 12	...	69°	97°	127°	156°	...	24·5°	...	29·9°	...	14·02°
13	...	59	89	118	147	...	24·5	...	29·8	...	14·07
14	...	51	80	109	138	...	24·6	...	29·6	...	14·11
15	...	42	71	101	130	...	24·6	...	29·4	...	14·15
16	...	33	63	92	121	...	24·7	...	29·2	...	14·19
17	...	25	54	83	112	...	24·7	...	29·0	...	14·22
18	...	16	45	75	104	...	24·8	...	28·8	...	14·24
19	...	7	37	66	95	...	24·9	...	28·6	...	14·26
20	...	359	28	57	86	...	24·9	...	28·4	...	14·28
21	...	350	19	49	78	...	25·0	...	28·2	...	14·29
22	...	341	11	40	69	...	25·0	...	28·0	...	14·30
23	...	333	2	31	60	...	25·1	...	27·8	...	14·30
24	...	324	353	22	52	...	25·1	...	27·6	...	14·30
25	...	315	344	14	43	...	25·2	...	27·4	...	14·29
26	...	306	336	5	34	...	25·2	...	27·2	...	14·28
27	...	298	327	356	26	...	25·3	...	27·0	...	14·27
28	...	289	318	348	17	...	25·3	...	26·8	...	14·25
29	...	280	310	339	8	...	25·4	...	26·6	...	14·22
30	...	272	301	330	359	...	25·5	...	26·4	...	14·19
31	...	263	292	321	351	...	25·5 N.	...	26·2	...	14·16

March 2: Summer Solstice of Mars' northern hemisphere. Sun's declination or elevation above the plane of the planet's equator = 27° 16′. (M.)

VARIABLE STARS.

Approximate times of minima (or maxima, where max. is mentioned) of variable stars, which according to Professor Schoenfeld (*Astr. Nachr.* No. 1807) and Winnecke (*Vierteljahrsschrift der Astron. Gesellschaft*, v. p. 246) may be expected in March:—

1871 March		G. M. T.		Place of star 1855. A. R. h.	m.	s.	Decl. °	′
2	...	9h·5	λ Tauri					
—	...	13·2	δ Librae					
5	...		R Leonis max.	9	39	45	+ 12	5·9
6	...	8·5	λ Tauri					
9	...	12·7	δ Librae					
10	...	7·5	λ Tauri					
11	...	14·1	Algol					
—	...		S Coronae	15	15	29	+ 31	53·5
13	...	11·5	S Cancri	8	35	39	+ 19	33·2
—	...		T Piscium max.	0	24	29	+ 13	48·0
14	...	6·5	λ Tauri					
—	...	11·0	Algol					
15	...		R Gemin. max.	6	58	37	+ 22	55·4
—	...		S Ursae mj. min.	12	37	35	+ 61	53·3
—			T Delphini max.	20	38	38	+ 15	52·5
16	...	12·3	δ Librae					
17	...	7·7	Algol					
20	...		R Leonis min. max.	9	36	52	+ 35	10·6
—	...		R Virginis max.	12	31	9	+ 7	47·2
21	...		R Sagittae min.	20	7	27	+ 16	17·4
23	...	11·8	δ Librae					
27	...		R Arietis max.	2	7	53	+ 24	22·9
—	...		T Canis min. max.	7	25	56	+ 12	3·0
28	...		R Boatis max.	14	30	48	+ 27	22·1
—	...		S Vulpeculae min.	19	42	27	+ 26	55·7
30	...	11·4	δ Librae					
31	...	15·9	Algol					

THE PLANETS FOR MARCH.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	21 36 41	−16 14	5″·4	22 57·5
	15th	23 5 42	8 8½	5″·5	23 31·3
Venus	1st	0 3 15	−0 54	10″·6	1 27·6
	15th	1 6 19	+6 19	10″·9	1 35·5
Mars	1st	12 25 25	+1 15	15″·7	13 47·7
	15th	12 8 24	3 2	16″·8	12 35·7
Jupiter	1st	5 3 42	+22 34	37″·5	6 27·2
	15th	5 8 44	22 42½	36″·0	5 37·2
Saturn	1st	18 34 57	−22 24½	14″·2	19 56·3
	15th	18 38 18	22 21½	14″·6	19 5·1
Uranus	2nd	7 39 12	+22 2½	4″·2	8 58·4
	14th	7 38 13	22 4½	4″·2	8 10·2

Mercury may perhaps be seen in the morning at the beginning of the month, but it is not well situated for observation. It rises about half an hour before the sun at the beginning of the month.

Venus is fairly visible at the beginning of the month, setting about 1.30 after sunset at the beginning of the month, the interval increasing to the end of the month.

Mars is well situated for observation all through the night at the end of the month. He rises before sunset.

Jupiter will still be visible till early morning. It sets at the end of the month at about 4h. 40s.

Saturn can be seen in the morning, rising towards the end of the month four hours before sunrise.

Uranus is very well situated for observation.

New Books.—Mr. Proctor's work on the *Sun*, and Professor Smyth's treatise *On an Equal Surface Projection*, will be noticed in our next Number.

NOTICES TO CORRESPONDENTS.

We are obliged to postpone, for want of space, the Rev. Mr. Ingram's article, "Sun Spots and the Solar Eclipse," and other valuable papers.

Erratum.—At page 27, for Buckingham read Birmingham.

Our readers may have noticed that No. 97 (January) was wrongly paged. We have reprinted the Number, as otherwise the 9th Volume would have been incorrect in this particular.

In deference to an expressed wish, the *Contents* are restored to the position they formerly occupied on the first page of the wrapper.

ASTRONOMICAL OCCURRENCES FOR MARCH 1871.

DATE			Principal Occurrences	Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon —
Wed	1		Sidereal Time at Mean Noon, 22h. 35m. 23·8			7 53·3
Thur	2	14 47 6 14 6 57	Conjunction of Moon and Uranus, 0° 46′ S. Occultation of Uranus Reappearance of ditto			8 44·8
Fri	3		Saturn's Ring: Major Axis = 35″·93 Minor Axis = 15″·46	3rd Tr. I. „ Tr. E. „ Sh. I. 2nd Oc. D. 3rd Sh. E.	6 1 8 44 11 18 12 14 14 5	9 37·0
Sat	4		Meridian Passage of the Sun, 11m. 58s. after Mean Noon	1st Oc. D.	12 33	10 29·2
Sun	5	15 57	Conjunction of Mercury and ι Aquarii, 0° 1′ N.	2nd Tr. I. „ Sh. I. „ Tr. E. 1st Tr. I. „ Sh. I. 2nd Sh. E. 1st Tr. E. „ Sh. E.	6 46 9 20 9 26 9 49 11 8 12 3 12 4 13 24	11 20·9
Mon	6	15 39	○ Full Moon	1st Oc. D. „ Ec. R.	7 2 10 34 41	12 11·7
Tues	7	20 7	Conjunction of Moon and Mars, 1° 27′ S.	1st Tr. E. 2nd Ec. R. 1st Sh. E.	6 33 6 45 38 7 52	Jupiter — 6 5·5
Wed	8					6 1·9
Thur	9					5 58·4
Fri	10			3rd Tr. I. „ Tr. E.	10 0 12 45	5 54·8
Sat	11					5 51·3
Sun	12			2nd Tr. I. 1st Tr. I. 2nd Sh. I. „ Tr. E. 1st Sh. I.	9 24 11 44 11 58 12 4 13 3	5 47·7
Mon	13	10 19	☾ Moon's Last Quarter	1st Oc. D. „ Ec. R.	8 58 12 30 31	5 44·2
Tues	14	13 43 17 25 18 24	Conjunction of Moon and Saturn, 0° 59′ N. Occultation of B.A.C. 6161 (6) Reappearance of ditto	1st Sh. I. 3rd Ec. R. 1st Tr. E. 2nd Ec. R. 1st Sh. E.	7 32 8 2 9 8 29 9 21 9 9 48	5 40·7
Wed	15		Illuminated portion of disk of Venus = 0·921 of Mars = 0·999	1st Ec. R.	6 59 24	5 37·2

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Thur	16		Sidereal Time at Mean Noon, 23h. 34m. 32·1			Mars 12 30·4
Fri	17					12 25·0
Sat	18		Meridian passage of the Sun, 8m. 16s. after Mean Noon			12 19·7
Sun	19	15 50 21 41	Opposition of Mars Conjunction of Moon and Mercury, 3° 7′ N.	2nd Tr. I.	12 4	12 14·3
Mon	20	16 0	● New Moon	1st Oc. D.	10 55	12 8·9
Tues	21			1st Tr. I. 3rd Ec. D. 1st Sh. I. „ Tr. E. „ Sh. E. 2nd Ec. R. 3rd Ec. R.	8 9 9 23 30 9 27 10 25 11 43 11 56 40 12 3 57	12 3·5
Wed	22	16 25	Conjunction of Moon and Venus, 4° 40′ N.	1st Ec. R.	8 55 14	11 58·1
Thur	23		Saturn's Ring: Major Axis = 37″·06 Minor Axis = 15″·82	2nd Sh. E.	6 40	11 52·7
Fri	24					11 47·3
Sat	25					11 41·9
Sun	26	9 17 10 23	Occultation of B.A.C. 1272 (6) Reappearance of ditto			Moon — 4 8·7
Mon	27	5 6 23 55	Conjunction of Moon and Jupiter, 1° 10′ N. Superior Conjunction of Mercury	1st. Oc. D.	12 52	4 55·8
Tues	28	18 44	☽ Moon's First Quarter	3rd Oc. D. 2nd Oc. D. 1st Tr. I. 3rd Oc. R. 1st Sh. I.	8 15 9 24 10 7 11 3 11 22	5 44·5
Wed	29	22 53	Conjunction of Moon and Uranus, 0° 59′ S.	1st Oc. D. „ Ec. R.	7 22 10 51	6 34·7
Thur	30			2nd Sh. I. „ Tr. E. 1st Tr. E. „ Sh. E. 2nd Sh. E.	6 34 6 49 6 52 8 7 9 18	7 25·8
Fri	31					8 17·2

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MARCH 1871.

By W. R. Birt, F.R.A.S.

Day	Supplement ☾ – ☉ Midnight	Objects to be observed
	° ′	
1	62 1	Copernicus,* crater chains between it and Eratosthenes.
2	50 42	Anaxagoras, its streak system.
3	39 4	Aristarchus,† Eratosthenes, aspect of interior.
4	27 5	Gassendi, its remarkable interior.
5	14 42	Hevel, Lohrmann, Cavalerius.
6	1 58	Cordilleras, D'Alembert Mountains.
23	147 34	Promontorium Agarum, Condorcet.
24	136 31	Taruntius, Messier, Biot.
25	125 36	Mare Nectaris, ridges on the western part.
26‡	114 47	Mare Serenitatis, ridges on the western part.
27	103 58	Mare Serenitatis, small craters near the Terminator, west of Linné.
28	93 5	Mare Frigoris, Timæus, Bond,§ Barrow.
29	82 2	Thebit. Straight Wall, Alpetragius.
30	70 43	Teneriffe Mountains,¶ Archimedes.
31	59 4	Bullialdus, Agatharchides,‖ Gassendi.

By adding the period of similar phase, 59d. 1h. 28m., to the epochs of observation of the appearances of objects in January, the time in March will be given at which the same objects may be seen under nearly the same conditions of illumination. The position of the terminator as given, for example, in the February Number, if continued, should be registered with each observation.

* Nasmyth's spiry shadow, see *De La Rue's Diary* 1868, may be looked for. I can find nothing like it: see *English Mechanic*, No. 291, p. 28.

† Browning's *second* peak in Aristarchus, see *Student*, April 1869, p. 192, may be looked for. Consult also *English Mechanic*, No. 296, p. 219.

‡ Winter solstice in N. hemisphere, N. pole in darkness.

§ A group of fine formations exists in this part of the moon, ill figured and badly described by Selenographers. The fine lozenge-shaped formation between Timæus and Barrow it is proposed to name Bond, in commemoration of the discoverer of the obscure ring of Saturn.

¶ A group of mountains S. of Plato on the Mare Imbrium, named to commemorate an astronomer's experiment: see *Monthly Notices R.A.S.*, vol. xxiv. p. 20.

‖ Adjoining Agatharchides is a ring nearly filled. It is not in Webb's Index Map, but is an interesting object for observation.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1870.

Field, H.
Huggins, Dr.
Kershaw, A. E.
Webb, Rev. Rev. T. W.

To January 1871.

Porward, R.

To March 1871.

Brothers, A.
Cotsworth, H. E.
Elliott, R.

To April 1871.

Lewis, H. K.

To June 1871.

Banks, W. L.
Gooch, Miss.
Slater, Jas.

To August 1871.

Locke, W.

To September 1871.

Pratt, H.

To December 1871.

Backhouse, T. W.
Baldelli, Mdme.
Barber, J. T.
Cundell, G.
Glover, Rev. J. H.
Hill, C.
Johnson, R. C.
Perigal, H.
Ryland, J. G.
Vernon, G. V.
Walker, G. J.
Whitbread, S. C.

To June 1873.

Banks, R.

February 20, 1871. Subscriptions after this date in our next.

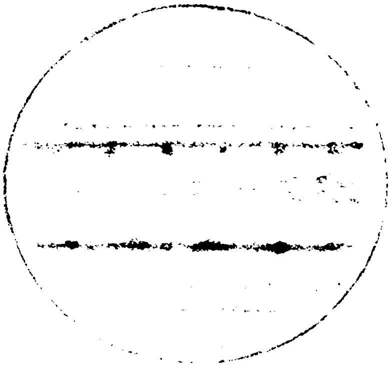
The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham, House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

OBSERVED AT Mr E CROSSLEY'S OBSERVATORY, PARK ROAD, HALIFAX.

JUPITER

1



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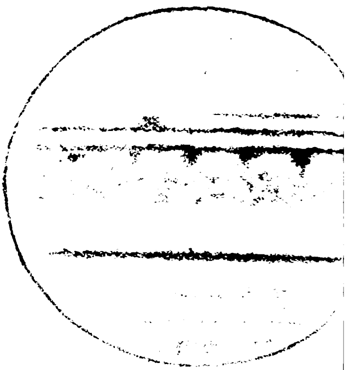
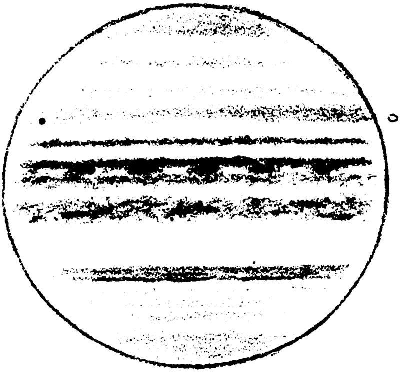
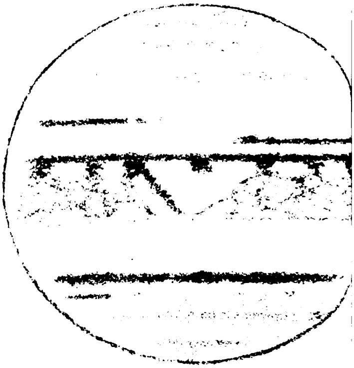


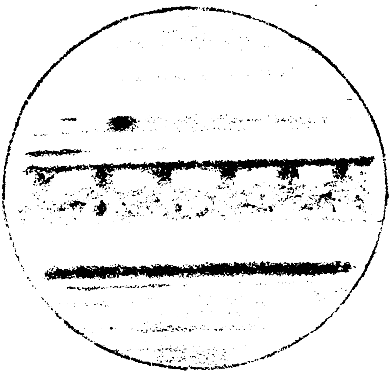
3



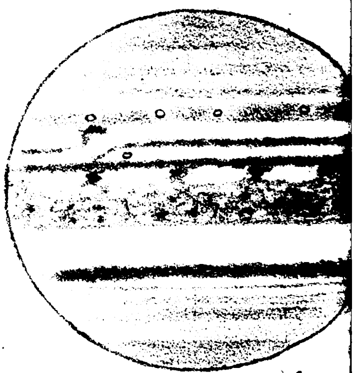
4



5



6



1 Sept 24th 1870 12h 30m G.M.T.
2 " " " 14h " " "
3 " 26th " 13h 15m " " "
4 " 20th " 15h " " "
5 Oct 10th " 12h 30m " " "

The Astronomical Register.

No. 100. APRIL. 1871.

OBSERVATIONS OF JUPITER.

By JOSEPH GLEDHILL, F.G.S., F.M.S.

At Mr. Crossley's Observatory, Park Road, Halifax.

Partly owing to bad weather and partly to the fact that, soon after a heavenly body has passed the meridian, houses and chimneys render good vision impossible, this planet has not been so carefully watched of late. The evening of March 4th was fine, and some observations were made on the present appearance of the disk. The minuter forms were, however, not well seen.

At 6h. 37m. P.M. No. 1 was well seen: near the west limb this band was darkest and broadest. No. 2 was dark and broad along its western half, while that of the east was fainter. No. 3 was either broader or much better seen than is usually the case.

The western half of No. 5 was fairly seen, its breadth being equal to that of No. 4. About the centre of that part of the disk this band seemed to fall down to No. 4. The eastern portion was not distinct. Five dark patches were seen under and in contact with No. 4 and having bright spaces between them: now and then these came out as festoons or ovals.

To the south of No. 5 was seen a broad dusky band about 3 times the width of No. 5. This is the position occupied by No. 6. It was not, however, seen clearly cut off from the shaded region of the pole by a brighter portion, as is often the case.

Its western and central portions were darker than the rest.

The amount of shading about the southern pole was strikingly greater than that about the opposite pole.

The broad central zone was carefully examined, and has been seldom better seen. It was not only less coloured and fainter, but also more distinctly dappled (the cloud-like patches being larger) than it has been hitherto noticed. The dusky region about the S. pole was but a little less deeply shaded than this central zone.

At 7h. 45m. the western half only of No. 1 was seen, while the eastern half of No. 5 was fully in view. This latter band at its western extremity

(now central) sloped down to No. 4, as did the eastern end of the portion seen an hour before.

P.S.—If Mr. Adams really observed a well-defined streak to the N. of band No. 1 (see *Register* for April 1870), the observation was well worth recording, independently of the rapid disappearance of the object: For neither during this apparition nor the last has any band or marking been detected nearer the N. pole than No. 1 at this observatory.

The Equatorial and Polar Regions.—Repeated observations seem to show that the depth of shade in these regions varies in different parts. Sometimes the shading about the S. pole is much deeper than that about the N. (Feb. 25th, 1871, at 7 P.M.) Sometimes the difference is scarcely perceptible (March 13th, 1871, 8 P.M.) The central zone has been seen but little darker than the southern polar region, as on the 4th of this month at 7 P.M., while at 8 P.M. on the 13th both poles were bright in comparison with the deep tone of the zone bounded by 3 and 4.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Fifth Meeting, March 10, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last ordinary meeting (January) were read and confirmed.

Sixty-four presents were announced, including a copy of the second edition of Professor Roscoe's most valuable work on *Spectrum Analysis.* The thanks of the meeting were voted to the respective donors.

William Mann, Esq., Royal Observatory, Cape Town; E. W. Snell, Esq.; and F. W. Levander, Esq., were balloted for, and duly elected Fellows of the Society.

Mr. Talmage complained that the latter part of his paper on the Eclipse, in which he recorded his thanks to some officers of Engineers who rendered him most valuable assistance, had been cut out in its printing in the *Monthly Notices*, and was informed by the Secretaries that the editor had full power in this respect over the printing of papers, and was referred to Professor Cayley for his reasons.

The following papers were announced and partly read:—

On a Mode of Protecting Observers when using Reflectors of large size in the Open Air: by Mr. Browning.

The author exhibited a model of his contrivance, and explained it orally. He said it was admitted that while large reflectors performed best when uncovered, this was certainly not the case with the observer, who was then exposed to the serious effects of wind and cold. He had therefore planned the model shown, and intended to have it carried out on the full size

necessary. The model consisted of three pillars, arranged on a triangular platform, movable on castors, between which a small room, suspended by pullies, and counterpoised, was made to ascend and descend by the change of weights in the room. This contained a desk for recording observations, and was well ventilated. The door could be fastened, to prevent the observer falling out, and to the upper open half a frame was fixed, by which a hood could be attached to the eyepiece of the telescope, thus keeping the wind off the observer, and placing his eye in complete darkness, as recommended by Mr. Proctor. Mr. Browning suffered much from exposure to the sun by day, as well as from cold, and he believed the white sides and ventilators would protect him from this inconvenience when observing solar phenomena.

Occultation of η Cancri: by Capt. Noble.

The times were given.

Note on the Occultation of Uranus: by Capt. Noble.

This was predicted for 14h. 7m. S.T. on February 3. The author adjusted his telescope on the planet, and at 14h. 5m. S.T. returned to witness the occultation, but found Uranus had already disappeared. Such an error in the *Nautical Almanack* is rare, except in the case of Jupiter's satellites, where the predictions are sometimes many minutes wrong.

Mr. Dunkin: The tables in use give an error of 15″ in the place of Uranus, and as the moon moves 2·5″ in a minute, this would produce an error of 4 or 5 minutes in the time of the occultation.

Note on the Misuse of a common Symbol: by Capt. Noble.

The author protests against the use of the symbol ″, which properly means seconds of arc, for any other purpose. In the *Monthly Notices*, he has recently seen "24″ E. of Greenwich," and that Dr. Robinson observed the eclipse with a telescope of "7″ aperture," meaning in one place seconds of time, and in the other inches.

The Astronomer-Royal: I always make a point of distinguishing seconds of time from seconds of arc; and as to inches, I write the word in full.

Mr. Penrose: It is now quite the fashion for engineers and others engaged in mechanical operations to use ′ for feet and ″ for inches.

The Astronomer-Royal: Perhaps there is some excuse in the original etymology of the words, which were:—*minuta prima* and *minuta secunda*; we have preserved *minuta* for the larger divisions and *secunda* for the smaller. Carpenters and such-like workmen are the only persons who use ″ for inches. It is convenient for them, who have nothing to do with astronomers or observations.

The President: I have been much struck by what the Astronomer-Royal has said, but the analogy is not carried out; ' *minuta* are not used for smaller divisions, but for feet, which are larger.

Mr. Penrose: It is quite hopeless to attempt to get carpenters and workmen out of this practice.

The Astronomer-Royal: I tried to get the marks altered, but without success. The Germans appear to be the greatest offenders in confounding seconds of time and arc, and using ″ for both, and inches as well.

Observations of the Solar Eclipse of December 1870, *made at the Royal Observatory, Greenwich*: by the Astronomer-Royal.

As this eclipse offered a favourable opportunity for detecting the errors of Hansen's Lunar Tables, the author arranged four sets of observations with the great equatorial and altazimuth. The measures included the N.P.D. of the cusps, the differences of the time (R.A.) of the limbs of the sun and moon, and the differences of N.P.D. of the north limb of each of those bodies. Some of the early observations were lost through clouds, but the remainder formed the data for five equations. The results obtained show that the tabular excess of the moon's R.A. over the sun's R.A. requires to be diminished by 6·47″, and the excess of the moon's N.P.D. over the sun's to be increased by 1·21″, while the semidiameter of the sun given by Leverrier's Tables requires a correction of −1·68″, and that of the moon from Hansen's Tables −0·49″. From meridian observations made on days preceding and following the eclipse, the tabular errors of the sun were found to be + 0·11^s in R.A. and + 2·2″ in N.P.D. The altazimuth observations of the moon during the eclipse showed the tabular errors in azimuth to be −11·0″ for the second limb, and −3·83″ for the first limb, the error of semidiameter being +3·5″. Combining these results, it appears that both instruments give precisely the same values for the tabular errors of the R.A. of the moon +0·54^s, and for N.P.D. + 1·0″ and + 2·5″ respectively. The coincidence in the error in R.A. may be accidental, but it is eminently satisfactory. From the altazimuth observations, the sum of irradiations of sun and moon amounts to 4·0″, while from those of the great equatorial, which has a much larger object-glass, the value appears to be only 0·5″.

The Astronomer-Royal: It may be desirable to add a few observations to this general *précis* of results, respecting the nature of the operations. I took no part in the observations myself, having found that it is now better to lay out the scheme with great care, and trust to younger eyes and younger energies to carry it out. In carefully considering what can be done with a large partial eclipse, I have found that observing the ingress and

egress gave only two data, and those very inaccurately; while, from the plan of observation here adopted, four things can be determined. In deciding on this scheme, I had the apparent places of the sun and moon computed for every five minutes, from which a diagram was made, showing the circumstances of the eclipse at short intervals during its progress. I studied this diagram for an evening or two, and determined on my plan, which I afterwards submitted to Professor Adams. At the beginning of the eclipse, the moon is advancing on the sun, and forms cusps. Now, if the tabular place of the moon relatively to that of the sun is too far advanced, the differences of N.P.D. of the cusps will be increased, and at the end of the eclipse they will be diminished. From these observations, we shall detect any important error of the tables in R.A. Again, at the beginning of the eclipse, if the tabular diameter is rather too large, the cusps will be lengthened, and the same effect will take place at the end. Thus an error in R.A. produces opposite effects at the end and at the beginning of the eclipse, but an error in the diameter produces an effect of the same kind at both times. The N.P.D. of the cusps must, therefore, be constantly measured. Other things are the differences of the semidiameters of the sun and moon, which will be found from the differences of the north limbs of the sun and moon near the centre of the eclipse; at other times we get the differences affected by errors of R.A. These observations are combined in various ways, and enable us to say in such a part we see various classes of errors. The observations are exceedingly delicate, and require great care. I decided to divide them into seven different parts, in each of which differences of N. P. D. only, without R.A. differences, gave equations for the satisfactory discussion of errors. One thing peculiar to Greenwich should be mentioned, and that is the mounting of the great equatorial, which enables us to measure differences of N.P.D. which could not be done with an instrument of the German form. I believe the equatorials of Greenwich and Cambridge are alone capable of this work. The moon passed nearly horizontally over the sun at this eclipse, and N.P.D. differences were therefore only used. At other times, R.A. differences were measured. The reduction of the measures presented extraordinary difficulties, and required much labour. It is one thing to say, Here are the tabular places of the sun and moon, where are the cusps? and to draw them on paper. This is easy, but to work out the results by figures is extremely hard. Another thing is, that having found out by the tables where the limbs of the sun and moon intersect, the result is complicated by the errors of R.A. and N.P.D., and in the semidiameters of both bodies, so that it becomes no joke to work it all out in algebra.

However, this has been done, and the result is worthy of the highest confidence. Four things have been attained—the correction of the R.A. and N.P.D. and the semidiameters of the sun and moon, and far better than can be got in any other way. One of the American astronomers went to Gibraltar not to observe the physical phenomena of the sun, but determined, when the shadow should pass, to trace by it the exact place of the moon. I told him I should do better at home. How it would have eventuated (as the Americans call it), I can't say. He had bad weather, and the telegraphs which he required to get his longitudes were interrupted, but we certainly obtained a good result by our complicated and laborious process. I have used this plan several times before, and even began it at Cambridge. It shows the necessity of having firm equatorials.

Erratum in the Results of the Observations of the Solar Eclipse, 1860: by the Astronomer-Royal.

On the Zodiacal Light: by Mr. Ranyard.

On the 19th December, while engaged on the Eclipse Expedition in Sicily, the author witnessed a brilliant display of the zodiacal light. The form was conical, but blunted at the apex. It was white, like the Milky Way. He tested it for polarisation with a Savart band prism, and at first thought he saw lines. He then called Mr. Burton, who saw some bands, with the centre black. Turning to the sky, even at 180° distance, it was free from these appearances. The next night was again fine, and Father Secchi thought he saw a faint band. These observations, if confirmed, show that the light is not only matter, but consists of small particles, comparable with the wave lengths of light or matter capable of specular reflection.

Mr. Brothers remarked that Venus would interfere very much with similar observations just now.

The President said he never saw the zodiacal light so fine as at Malta, but it was of a different colour to the Milky Way, being redder.

Captain Noble referred to a paper of his, in which he stated it was brighter than the Milky Way. That paper had a different object, viz., to show that the zodiacal light did not lie in the plane of the ecliptic, as popular books on astronomy taught. His observations were on spring evenings.

The Astronomer-Royal inquired whether anyone had seen it on autumn mornings?

Mr. Penrose said he did last year, when travelling in Spain, when it was very brilliant.

Note on the Corona: by Mr. Proctor.

Mr. Proctor stated that this paper called attention to the important result shown by the agreement between photographs

taken by Mr. Brothers in Sicily and the American observers in Spain as to the configuration of the outer or radiating part of the corona corresponding with the inner and brighter part, which confirmed the explanation of the corona as a solar appendage.

Note on the Distribution of 326,000 *Stars in Argelander*: by Mr. Proctor.

In the discussion upon Mr. Proctor's papers on the Distribution of Stars, he had been advised by Professor Pritchard to test his views by their application to Argelander's Zones. He therefore now proposes to map the number above mentioned on four large sheets, and have these reduced by photography. This would bring the stars so close as to run into one another, and produce a sort of graining, which would indicate the direction of their tendency to mass together, and, the author believes, give some important results.

On the Colour of the Moon during the late Eclipse: by Mr. Proctor.

The green colour of the moon described by some observers in Spain might at first seem to be connected with the green line in the spectrum of the corona, but the colour of the corona was not at all green, and this will not account for the observed tint. If, however, we consider the appearance of the face of the earth which would be turned towards the moon, it would probably be mostly green or blue, and the earth, as seen from the moon, being fourteen times as large as the moon is to us, we shall understand that a considerable amount of greenish light might be received by the moon and reflected back to the earth. The spectrum of this light would be continuous, but was doubtless too faint to be recognised. In 1860 the colour of the moon is described as reddish; and as a different part of the earth, having much more land, was then turned to the moon, this is equally explained. The curious result follows that the earth as seen from Venus may be variable in colour, and that the changes may be used to determine the rotation periods.

Mr. Ranyard: There is another way of accounting for the green colour. If the light be polarised and reflected back twice between the moon and earth, one end of the spectrum may be cut off at one body, and the other end at the other, and thus the middle of the spectrum remain. Professor Stokes has accounted in this way for a strong green colour seen between two banks of clouds.

The Astronomer-Royal remarked that all statements of colour should be received with great diffidence, on account of the effect of contrast in producing illusion as to colours.

Captain Noble instanced the well-known experiment of looking at an object of one colour, and finding its complementary tint produced on looking elsewhere.

Mr. Hudson stated that the moon looked green in the telescope, but black to the eye alone; and that he thought his eye was not very sensitive, and therefore unlikely to be much affected by contrast. During the voyage home, when Professor Tyndall was experimenting on the colour of the water in the screw-well, he (Mr. Hudson) had some difficulty in detecting the various colours.

The Astronomer-Royal asked Mr. Dunkin whether, during the eclipse of 1851, he did not see the water at Christiana yellow.

Mr. Dunkin said that the sea was there full of islands covered with green trees, all of which looked yellow, but the water between looked deep purple.

Mr. Brothers then exhibited a series of photographs taken by him at Syracuse, during the eclipse, and some other illustrations of the results of the expedition, by means of a lime-light lantern kindly supplied by Professor W. G. Adams, of King's College; and some stereoscopic photographs of the eclipse, showing that, by combining the second and fifth pictures taken during totality, the moon stood out away from the corona. The two first pictures were views of the telescope and observatory; then came one of the partial eclipse, taken at Manchester with a very small picture, showing the effect of cloud in lighting the moon, and one of the prominences as seen before the eclipse. Five photographs of the totality were next shown, two of them exhibiting the corona in great beauty; and the last illustration was a combination of the photographs of Mr. Brothers and Mr. Willard (taken in Spain), and a drawing by Professor Watson, made at Carlentini, all agreeing exactly as to the position of the rifts in the corona, and thus proving that it was situated near the sun, and not affected by distance or atmospheric causes. Letters from Sir John Herschel and Dr. Balfour Stewart were read to the meeting by Mr. Brothers, assenting to this view. The time of exposure of the plates varied from 8 to 15 seconds. The apparatus used consisted of a camera with a lens of 30-inches focus, made by Dallmeyer, mounted on an equatorial telescope.

Dr. Huggins said that, it being doubted whether the rifts were shown as identical in the photographs taken by the Sicilian and Spanish parties, he made an appointment with Professor Winlock to examine them, and found, upon the most careful comparison, that the two principal gaps were certainly identical, and two others nearly so.

Mr. Ranyard: In Lord Lindsay's pictures, the effect is marred by the wires across the plate looking like crowbars, which obscure the parts where some of the rifts would be well seen.

Mr. Hudson: Paper pictures from the American photograph and that of Mr. Brothers being mounted on a card, if placed correctly, show the correspondence of the rifts distinctly. As to my

sketch, if compared with Lieutenant Brown's, it shows a great similarity, although my business being polarisation, I could not devote much attention to drawing.

Abstract of the Report of the Agosta Eclipse Expedition: by Professor W. G. Adams (King's College). In consequence of the lateness of the hour, Professor Adams merely stated that his paper mentioned he was himself unable to do much with the polarisation apparatus, but that Mr. Clifford, through the cloud, saw some traces. Mr. Burton confirmed the existence of the American green line in the spectrum of the corona, and Mr. Brett made some coloured drawings.

Mr. Brett, the eminent painter, then exhibited the three beautifully-finished drawings made by him, with the aid of a silvered-glass reflecting telescope of 8½-inches aperture, and a small achromatic refractor. The first showed the thin line of light just before totality, with a very curious brush issuing from each cusp. In the second, the thin line was seen breaking up into Baily's beads; and the third, taken during totality, exhibited the red flames and sierra of prominences in an exquisite manner.

Mr. Brothers enquired whether the limb of the moon seemed to the eye to be surrounded by the red light of the prominences.

Mr. Brett: The drawing shows all I saw. The prominences were heaped up in patches of red, yellow, and white.

The Solar Eclipse: by Rev. S. J. Perry.

The meeting, which was very crowded, then adjourned.

RED LINE IN AURORAL SPECTRUM.—On your p. 55, in the report of the Royal Astronomical Society, it is stated that the red line in the auroral spectrum was observed first on April 5, 1870. This is a mistake, it is mentioned in my letter which is printed in your number for August 1869, p. 185. T. W. B.

FUTURE ECLIPSES.—I fear, unless some one of our contributors has the requisite tables and leisure, the questions of "Astronomicus" will remain unanswered for some time. I have not tables of the moon's epochs extending so far as the dates in question. G. J. W.

W. J. McD.—The monthly notices of the Royal Astronomical Society are included in the bound volumes of the Memoirs of the Society, and are sold to the public (at prices according to the size or contents of the volume) by Williams and Norgate, Henrietta Street, Covent Garden.

SOUTHERN LATITUDES.—We shall be very glad to receive occasional notes from our correspondent at Sydney, and have no doubt they will prove interesting to our readers. No new edition of Admiral Smyth's *Cycle* has yet appeared.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

SUPPOSED CHANGES IN THE MOON.

Sir,—My excellent friends Messrs. Birmingham and Lynn having appeared on the arena of controversy as regards the vexed question of "Linné," will you allow me in the briefest space possible to offer two or three remarks on the subject?

First: The acquaintance of English selenographers with "Linné" dates, so far as I am aware, from 1866, October 16. Between the early part of February 1867 and the present time, or rather 1871 January 27, the date of the last observation which has reached me, "Linné" has been seen as a craterlet, not exceeding a mile in diameter, and during the interval no indications of a physical change have occurred. 1871, February 26, 6·10, I observed "Linné" with 2·75 inches aperture as a slight depression very similar to the object in the Mare Crisium which I noticed after the cloudy patch west of Picard had *disappeared*, and which I believe is recorded in your pages. The usual cloud-like appearance characteristic of "Linné" at a later illumination was absent. Of course I failed to see the craterlet with this aperture.

Second: I have been waiting for the last four years for some *evidence* of the inaccuracy of Lohrmann's, Beer, and Mädler's and Schmidt's drawings and descriptions of "Linné," but have hitherto failed to obtain any. There may possibly be among your readers gentlemen who may be able to supply this desideratum founded upon data *otherwise* than the different aspect which the crater now presents to that which it must have presented if those drawings and descriptions are correct.

Third: It is exceedingly important in an enquiry of this kind to hold "opinions" very loosely. The perception of truth may be long retarded if *they* be held tightly and defended with energy. On the other hand, the patient collection of "facts" tends greatly to establish the truth. It is the *fact* of the inaccuracy of former selenographers which we need to determine the question.

Yours truly,

Walthamstow: March 3, 1871. W. R. BIRT.

PERFORMANCE OF A ZENITH SECTOR.

Sir,—I have just read in the December number the report of Col. Strange's paper "On the performance of a Zenith Sector, &c.," read at the meeting of the R.A.S. held Nov. 11, and feel called upon to rectify some extraordinary mistakes, and explain some very unmeaning extracts therein contained. It is unnecessary to speculate what shares are due respectively to Col. Strange, to your reporter, or to your printer in the confusion, resulting in great measure, apparently, from the shortness of the verbal extracts from my letter to Col. Strange. I refer to a copy of that letter to aid me in rectifying.

1. I have no idea what is meant by my having measured a base line

between March 20 and April 4. I never measured a base line in my life (though I have aided in doing so in previous years); and if I had, what has it to do with the matter in hand? The extract which follows is not so accurate as, I do not doubt, it is in Col. Strange's paper.

2. The expression "five minutes as a limit for closing a star list" should be "for choosing a star list."

3. The accuracy of the graduation is inadequately represented by saying merely that "no error exceeds 2″"; that might well be taken to mean that no *space* is 2″ in error. But this was not at all what I intended when I wrote, "I question whether the error of position of any division exceeds $\pm$ 2″ as compared with the mean of all." As I believe that the magnitude of each division is nearer × 10″ than 4″, this amounts to saying that were a mathematically true series of radii, 5′ apart, applied as a test, every such radius would fall nearer to the middle than to either side of its respective graduation.

4. The next sentence, "No instrumental error is more than 1″ after 6 or 7 hours' work," is unsupported by anything I have written, except the following, which I give *in extenso*, as it explains the condensed statement, to which I object as both vague and misleading: "My observation-record is made to show the zero-error of microscopes at every observation (generally before passing on), so that mistakes may be detected on the spot. This is a joint test of graduation, intersection, and observation errors, as well as of stability; and it is satisfactory to find that the extreme range is not greater than $\pm$ 1″ for 6 or 7 hours' work." The "stability" referred to here is not that of the axis of rotation (except during the minute between the two star intersections), but of the microscope arms and other parts subject to change of zero; not, however, including the levels. I should add that I reject, unhesitatingly, any observation which gives a zero-error, unexplained by irregularity of circle readings, differing by 1¼″ from the mean, because I am satisfied that 1″ is the extreme limit to be expected. The rejections of this kind do not amount to more than three or four in 1,000.

5. The sentence which immediately follows contains an exaggeration. I wrote that "in about *three cases out of four*" all the members of a triplet fall within a range of 1″.

6. We come next to accuracy of result. Generally speaking, it is not fair to exclude individuals of a group, when precision is under consideration, without cause shown. In this case, out of the 50 stars observed, only 22 were immediately available; and of these, two were rejected for reasons then only surmised, but since proved sufficient—the erroneous place of Procyon in the N.A. for 1870, and the non-identity of individuals in the case of γ Virginis.

7. The next sentence is best read by the help of the original. It is only necessary to say that, as my experience as an astronomical observer was *nil*, I referred merely to my practical acquaintance with *angular measure* of a high order, viz. that with the best modern surveying instruments. The following extract, the last which I need make, also explains the strange sentence further on about "the error" being "reduced to 0″·2." "I would not be over confident, but the *order of accuracy* indicated by these flying reductions has no parallel in my experience. I take no credit on the score of observation; I attribute it wholly to the instrument, and believe it can do still better. As regards latitude only, I am satisfied that one night's observations (of 36 stars in six hours) will suffice to give a result whose probable error will be *not greater than one-fifth of a second*."

I think, Sir, that I am entitled to ask for the insertion of this letter, on the score of justice; for, dear as is the reputation for accuracy to us all, it is so in an especial degree to those whose vocation is scientific; to none

more so than to myself; and in this particular instance I am misrepresented as making unqualified statements which, where they are not of doubtful meaning, are of doubtful correctness.

I am, Sir, yours truly,
J. HERSCHEL, Capt. R.E.

P.S.—The accuracy of a Zenith Distance observation, or (as in Talcott's method) of that of the difference of two Zenith Distances, depends directly on the "level correction." However perfect other things may be, or however ingenious the method, imperfection of levels mars all. *Levels are now inferior to graduation.* Until that is rectified, Talcott's method is at too great a disadvantage. That is a sound practical objection, in addition to others of a more special character, depending on the objects and purposes in view. I take occasion to say so here, because the time has come to urge on manufacturers that the inaccuracy of level curvatures is becoming an insuperable obstacle, which they alone can remove.

J. H.

Cape Comorin Base: Jan. 15, 1871.

SOLAR SPOTS.

In the *Astronomical Register*, No. 92, Aug. 1870, p. 184, is an article entitled "Solar Spots." Permit me to suggest the following as a more satisfactory method of delineating the spots, when it can be applied to a telescope which is accurately driven by clock-work, viz.: a square of glass is kept in position behind the eye-piece by means of a frame held by a bracket or support sufficiently strong to prevent vibration, and resist moderate pressure of the hand: this to be clamped upon the eye-piece end of the telescope. Upon one surface of the glass a piece of *thin* tracing paper is pasted, and when dry is ready for use, as a screen, by being fixed in the frame by a "button," and the image of the sun focussed upon it. It will be found that upon the tracing paper thus fixed, the position and much of the detail of the spots can be traced with a fine pencil. It is scarcely necessary to add that several plates of glass (accurately cut to a gauge, so as to be easily introduced into the frame) should be in readiness; each prepared with its tracing paper, for any number of powers used in carrying out the detail of the spots. When the drawings are finished, each plate with its paper is to be introduced, for a few minutes, into a vessel of water, after which the paper may be easily removed from the glass and mounted as best desired, upon stout white paper.

Yours, &c.,
North Shields: Feb. 4, 1871. W. B. CLARKE, M.D.

P.S. In laying down the line of meridian or parallel upon the drawing, I would suggest the following arrangement, viz.: that fine wire parallels should be stretched across the surface of the frame nearest to the eye-piece, the meridian line corresponding with the axis of the telescope; between these wires and the eye, the plates of glass, with their tracing paper, are to be adjusted. Previous to the position of the spots being noted, the sun's limb, E. W. N. & S., must be made to correspond with the shadow of the respective wires, and the meridian and other parallels carefully drawn, with rule and pencil, over the shadows respectively, *under a low power.*

Upon using the higher powers to display the detail of the larger spots, &c., I would suggest that, after the general view of the solar disc, the meridian and other parallels have been drawn, and the disposition of spots

pencilled in, under a *low power*, the necessary adjustments, horizontally and vertically, must be made by the telescope, so as to bring each spot or group of spots, into the centre of the tracing paper, after each power is adapted, and the focus adjusted.

The progress of the spots each day (or at each determined period) will be shown by marking them carefully with the point of the pencil; drawing the meridian and other parallels, under a sufficiently *low power*. Dots made at the four cardinal points of the sun's disc will enable the circle to be completed by a disc of card laid between them, and drawing the circle round the circumference.

REVIEWS.

The Sun: Ruler, Fire, Light, and Life of the Planetary System. By R. A. Proctor, B.A., F.R.A.S. (London: Longmans).

A complete work on the sun would almost of necessity be a complete history of astronomy, for no branch of the subject can be treated without reference to the mighty globe which occupies the centre of that system in space of which our world is a part. That which can be done without extending the work to impracticable dimensions has been done, and we need scarcely say done well, by Mr. Proctor, in the welcome addition to astronomical literature which now lies before us. It is a very different matter to write a work upon the sun in the present day, to what it would have been only (let us say) five-and-twenty years ago. Discovery has followed discovery of fresh methods of observation; photography, the polariscope, and the spectroscope, in the hands of observers of unrivalled ability, have opened fields of research which but a short time ago were totally unexplored. It will be readily imagined, therefore, that a large portion of Mr. Proctor's work is devoted to modern discoveries on the solar surface; in fact, our author candidly states that he does not attempt to give an account of the steps by which our knowledge of the sun's central position in the solar system has been obtained. The question of the sun's distance, however, so lately re-determined by the most accurate methods obtainable by modern observers, is thoroughly gone into; and the importance due to the approaching transits of Venus, whereby we may hope to confirm the recent measures of the solar parallax, is properly appreciated. The great part played by the spectroscope in giving us indications of the structure of the solar surface is dwelt upon, the methods of observation explained, and the instruments described; the physical condition of the sun is considered, and the researches of astronomers in the great question of the system of suns, of which our luminary forms a part, is dealt with, as far as modern astronomical enquiry enables the subject to be treated.

A profusion of explanatory woodcuts and many excellent coloured lithographs adorn the work, and we feel sure that this latest contribution by Mr. Proctor to the astronomer's library will be received with satisfaction not only by those especially interested in solar research, but by the scientific public generally.

On an Equal Surface Projection for Maps of the World. By Professor C. Piazzi Smyth, F.R.SS. L. & E.

This interesting paper was in its first and shorter form read before the Royal Society of Arts in Scotland on May 9, 1870, but has been subsequently enlarged and published. Its object is to produce maps "representing the

whole world at one view, and in the most equal possible manner." This could never be with the old Mercator's maps, where there is always a great distortion of the apparent sizes of the polar over the equatorial portions of the world, to a degree beyond the power of mere eye and judgment to correct at every step. The mode of getting over the difficulties is best described in the Professor's own words:—"The disadvantages may be instantly eliminated by simply representing the latitudes as *sines* upon an otherwise Mercator's projection, and adopting at the same time the arc length of 90° for the radius or straight meridional distance from the equator to the pole, and then we have not only the very poles themselves definitely included on the paper, but the areas of parts between different latitude parallels and longitude meridians, made of the same proportions as on a true sphere; while the distortion which is inherent in every representation of any sphere's surface on a plane is nearly confined to a flattening of the extreme solar regions, for at 50° 13′ of latitude the proportions of the latitude and longitude degrees are true, and below that, though there is an extension in latitude, it is comparatively slight." Such a map once projected may be used for a variety of purposes. The Professor applies it to the temperature of the earth's surface—to barometric pressure—to the world's land and sea surface, but the chief and most novel application is to the deciding upon the earth's centre. Hitherto each particular country has looked upon their own land as of central importance. The ancient Greeks spoke of Delphi as *μεσόμφαλος*; the navel stone, as it were, of the whole earth. Modern savans of London speak of it as the centre of all the land surface of the world, but then they include the unhabitable polar regions, and exclude South America and Australia. Some say Liverpool, and so on. But by reference to his map and the tables deduced from a study of it, having regard to climate and other points connected with the existence of man upon the face of the earth, he comes to the conclusion that there is a definite longitudinal meridian which might, with great propriety, be fixed upon as a starting-point for all nations, and that thus the inconvenience of Frenchmen reckoning from Paris, the English from Greenwich, the Portuguese from Ferro, others from Washington, Berlin, Altona, Pultowa, and Vienna, might be corrected by choice of one place, and this he thinks not only possible but reasonable, and free from objection and even likely of acceptation. "By referring to Tables III. and IV., it will be perceived that they make the land surface toward the north to be exactly equal in extent to the land surface towards the south on either side of a certain latitude parallel, not the parallel of London (where the proportions N and S are 13 to 59), nor of Delphi (where the proportions are 24 to 48), but of the far more southern latitude 25° 30′ N. (where the proportions are 36·12 to 36·12 as was seen Line AA on Plate IV.) While the world's same total land surface towards the west is equal to that towards the east on either side of the longitude meridian of either 29° 5′ E. or 150° 55′ W. (see lines BB and bb on Plate IV.) giving two crossing points with the latitude parallel for the land centre of the earth's surface—between these two we can have no difficulty in choosing, for 150° 55′ W. traverses little or nothing but sea from pole to pole, while 29° 5′ passes over far more land than sea. There are other separate results pointing to a meridian between 25° and 35° East as having the honour of making or including the longitude meridian of the only unexceptionably measured centre of all the *inhabited and inhabitable* land surface of our globe." The conclusion is that the great pyramid of Egypt, a building of itself admirably fitted for a longitude monument, should mark a first meridian for all the world. The maps which explain these theories are very well executed and particularly clear.

The Rev. J. H. Broome's ingenious pamphlet upon the astral origin of the Hebrew Alphabet has been reprinted from the *Register*, and may be had in a separate form of Mr. Macintosh, 24 Paternoster Row.

NOTES ON THE WONDERS AND BEAUTIES OF THE STARRY HEAVENS.

By C. Grover, Assistant to John Browning, Esq., F.R.A.S.

No. 3. The Constellation Lyra.

This compact and elegant little asterism, though of much less extent than the constellations of Ursæ Minor and Cassiopeia, which have previously engaged our attention, contains several objects of so much beauty and interest as to richly reward the attentive observer who may devote any portion of his time to their examination; in fact, bearing in mind the limited area occupied by its outline on the celestial vault, this constellation is exceedingly rich in telescopic work. Its position in the heavens is such, that it transits the meridian at convenient hours for observation, during the summer and autumn months. The R.A. of Vega, the lucida of the asterism being 18h. 33m., it follows that on the first days of August, September, and October, it culminates at 9h. 45m., 7h. 49m., and 6h. 2m. respectively; and its distance north of the equator, amounting to 38° 40′, is such as to place it just within the circle of perpetual apparition for our latitude, so that under favourable atmospheric conditions, and in situations free from obstructions, it may be seen at its lower transit, just above the Northern horizon; at the upper transit its altitude of about 76° makes it a rather inconvenient object for the achromatic telescope, but, as we have previously pointed out, this causes no inconvenience to the Newtonian reflector.

The student may feel interested in comparing the light of this first-class star with a few of the other gems of our northern hemisphere, as Sirius, Arcturus, Capella, and Procyon, especially when we bear in mind the fact that such estimations, conducted by the most able observers, are far from being so accordant as could be wished; and it must be admitted that the science of Photometry, or light-measuring, is in a somewhat unsatisfactory condition; not altogether from a want of proper instrumental appliances, or from any lack of skill in the observers, but in a great measure owing to the actual impediments which bar the path of the student who wishes to arrive at accurate conclusions as to the relative brightness of the stars.

Of the four stars just named, the first is by far the brightest ornament of our hemisphere, and Vega, though of inferior lustre, ranks next in order of brilliancy; but we think few of our readers will agree with Wollaston, who allowed it but $\frac{1}{9}$ of its brightness, for, as the Rev. T. W. Webb very justly remarks, nine Vegas compacted into one would surely outvie any star in the firmament. Procyon ranks next in order, followed by Arcturus and Capella; the difference in brilliancy of these last two stars being so minute, that I have often found a difficulty in deciding which was entitled to the pre-eminence. These differences are easily seen, but an exact determination of their relative luminosity could not be made so readily; for this purpose it is obvious that the objects under examination should not greatly differ in altitude, should be situated in equally dark portions of the heavens, the atmospheric conditions must be very favourable, and the moon quite absent, added to which the optical capacity of the instrument employed must have been well determined by previous observations of some objects

of well-known magnitudes; and lastly, any peculiarities of vision to which the observer may be liable must be duly considered and allowed for. The fulfilment of all these conditions is a matter of extreme difficulty; but the student who diligently labours in this department of astronomy will find his reward in the discovery of more diversity of brilliancy among the stellar host, and even among stars recorded by our best authorities as of similar magnitudes, than is generally supposed. In saying this we do not overlook the fact that many such discrepancies may be due to actual changes, of which we have many well-known examples; but there still remains a considerable number of disagreements, which may be fairly attributed to the difficulties just mentioned. A large telescope with low power shows this fine star, with many lesser companions, including two faint pairs; one, N.P., the other, S.F., and it is inserted in the catalogues of most double-star observers, on account of an 11th magnitude companion, distant 43″, on a position angle of 135°, another somewhat brighter star lying nearly at right angles to this, and at about three times the distance. These were the nearest known companions of the great star till Mr. Buckingham announced at a meeting of the R.A.S. in 1867 the discovery, with his 20-inch achromatic, of three other most minute points, much closer to the primary than those just mentioned. He has been able to verify their existence with a 9½-inch object-glass; and one is stated to have been seen with only a 5⅜-inch achromatic. I am not able to add anything from my own observations as to these delicate objects, though I have repeatedly searched for them with the 12¼ speculum, and powers up to 500. On several occasions I have noticed minute points of light which might have been taken by a casual gazer for the objects sought, but I could never satisfy myself of their reality; and to prevent the least tendency to any bias on the subject, I carefully avoided any reference to the published positions and distances, and they are purposely omitted here in the hope that some reader possessed of adequate optical means may be induced to undertake an independent search for these interesting objects.

Referring to the difficulties incidental to measuring, the late Rev. W. R. Dawes, speaking of the 11th magnitude companion, remarks: "The small star bears more illumination than might have been supposed from its minuteness;" and the statement that Sir John Herschel's 18¼-inch speculum showed it immediately after sunset, and with a moon, has been instanced as a proof of the light-grasping power of the metallic disc. As much has been done with the 12¼ silver or glass speculum, in which I have several times seen it within a few minutes of sunset; and on the 23rd of September 1870, it was beautifully distinct in Mr. Brindley's 8½-inch equatorial reflector, within less than half-an-hour after sunset, and in such broad twilight that the smallest figures of the *Nautical Almanack*, and the graduated circles of the equatorial, could be read without the least difficulty. The beautiful blue tint of this little star is particularly distinct on such occasions, and affords a striking proof of the superiority of the silver film over the metal mirror so far as illuminating power is concerned.

The Monthly Notices of Papers and Proceedings of the Royal Society of Tasmania for March, April, and June 1870 contain several valuable articles, including contributions to the phytography of Tasmania, by Dr. Ferd. von Müller, and some additional observations on the more recent changes which have taken place in the star η Argus and its surrounding nebula (with diagrams) by Mr. F. Abbott.—*Nature.*

SOLAR SPOTS OBSERVED DURING THE ECLIPSE

BY THE REV: T. INGRAM, STEYNING, SUSSEX.

FIG. 1.

(Inverted image)

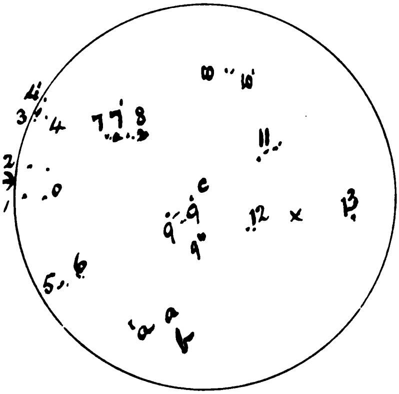
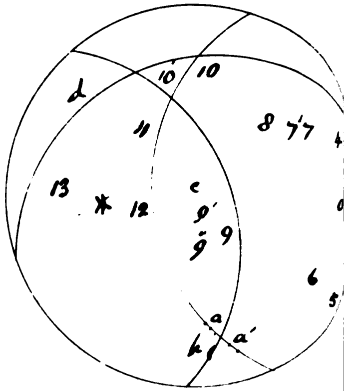


FIG. 2.

(Non-inverted spectrum)



STANDARD NUMERALS DESIGNED BY COL. A. STRANGE, F.R.S.

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NUMERALS DESIGNED BY R. S. NEWALL, ESQ.

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NOTES OF SOLAR ECLIPSE AT STEYNING, SUSSEX, DECEMBER 22, 1870.

Observed time of commencement 11h. 7m. 40s.* at the point marked with arrow in diagram (¹). Wind E.N.E., nearly calm, but with occasional gusts of force 6 (one such gust directly after commencement of eclipse) .

Obscuration of spots as numbered in diagram (¹) (first contact unless otherwise stated).

Spot	No.	Observed time h.	m.	s.	Watch probably about 40ˢ too slow, G. M. T.	
	0.	Not seen until after mid-eclipse				
	1.	11	9	40.		
	2.	11	9	50	(?) *not exactly* (Wind almost calm).	
Group of spots near Sun's W. Limb.	3.	11	10	20	(immersion).	
		11	11	10	(total disappearance).	
	4.	11	13	33	(therm. (4 ft. from ground) in shade 26°.	
	4'.	11	12	35.		
	5. 6.	times not observed (very small spots).				
Large Group of spots.	7.	11	31	18	1st contact with penumbra.	
		—	31	35	„ „ umbra.	
	7'.	—	32	38	„ „ penumbra	Wind freshening E.N.E.
		—	33	17	„ „ umbra	
		—	34	0	total disappearance „	
Largest of large group.	8.	11	38	4	1st contact with penumbra	Thin cirrus clouds crossing.
		—	39	2	1st contact with umbra	Good definition obtained here.
		—	40	28	total disappearance of umbra	Time exact.
		—	—	—	total of penumbra not observed (clouds crossing in fresh E.N.E. current).	
Small central group	9.	11	37	29	1st contact, or immersion.	
		—	39	2	total disappearance.	
	9'.	11	42	19	immersion.	
		—	—	—	total disappearance not observed.	
	9''.				not observed till after mid-eclipse.	
	10.	11	52	19	immersion.	
		—	—	—	total disappearance not observed.	
	10'.	—	53	15	immersion.	
		—	—	—	total disappearance not observed.	
Group of 4 small spots.	11. 1.	12	6	18	immersion	Sensible diminution of light (with yellow tinge) at 12h. 13m.; giving a penumbra of about ½-inch to one's shadow on a white door.
	2.	—	7	55		
	3.	—	—	—	not observed	
	4.	—	12	12		
	12. 1.	—	1	4	immersion	
	2.	—	—	—	not observed	
	13.	—	20	35	immersion.	
		—	—	—	total disappearance not observed.	

* Calculated time of commencement 11h. 6m. 58s.

† Misplacement of No. 12 in diagrams.

N.B.—The Moon's position is *approximately* given in diagrams at 11h. 50m., 12h. 23m. 40s. (mid-eclipse), and 12h. 47m. (the latter position being taken without data to fix it).

Steyning, Sussex,

Lat.	50° 53′ 20″ N.	9½ miles N.W. by W. from Brighton (see Mr. Hind's letter in *Times*, 19th December).
Long.	0 19 30 W.	

Notes on diagrams (1) (2). The position of the groups of spots is only given with approximate accuracy. Group 11 is, I think, too near *c*, the sun's centre. The arc *d* gives a larger mid-eclipse than was seen. The spots as given can easily be identified on a photograph of sun.

Apparent bluntedness of horns of Sun during the Eclipse.

Observed time

h.	m.	s.		
11	27	30	lower horn	Good definition was often impossible from the wavy appearance of lines, owing to the radiation of heated moist air from the ground.
11	29	20	upper horn	
11	48	29	lower horn	
12	11	40	upper horn	

Observations of the limb of the Moon.

h.	m.	s.	
11	50	0	Mountains observed on eastern limb, as roughly marked at a, a, in diagram (1), like grains of sand on a smooth edge. (Good definition obtained.)
12	49		Valley in western limb, as roughly marked at b in diagram (1).

Miscellaneous Notes.—Position of observer, *a warm nook, sheltered from N.W. and N.E.* Rotundity of moon very observable by the play of yellow light on the parts nearest the sun, shading off to darkness at centre. No Bailey's beads observed. No planets seen, though carefully looked for. Wind E.N.E. throughout. Clouds more frequent in S.S.E. quarter at about 12h. 43m. to 12h. 53m. Detached cirrus, lower sides murky, of a purplish copper hue, at 12·53 (reflecting the darkened landscape), upper sides often of a pinkish copper tint, specially on an apparent arc about 12° above the sun, at 12h. 53m. A few flakes of snow at 12h. 58m.

* Thermometer readings in sun

Time—	h.	m.	s.	°
	12	13	0	33
	12	15	0	32
	12	20	0	31
	12	35	0	29
* A spirit minimum thermometer	12	43	0	28
	12	53	0	30
	12	57	0	32
	1	43	0	42

Telescope by Dollond, 2-inch aperture, power 50 lineal.

Barometer not read. It was steady at (29·79-in.) Cocks crowing very much at 12h. 13m. Birds fighting for roosting places as at evening. Starlings changing direction of flight as if baffled. Pigeons taking short low flights round.

All observations after mid-eclipse were interrupted. No times of reappearances noted.

Colonel Strange's Standard Figures for Astronomical Instruments.—We give with this number a drawing copied from a photograph sent us by Colonel Strange of the standard figures designed by him for engraving on the circles, &c. of astronomical instruments. Many subscribers have expressed a wish that we should give this illustration; it is not, however, intended as a *standard* illustration of the figures, but is perhaps as near an approach to the original as our means enable us to give. Colonel Strange writes us to

say that he has as yet met with no one able to copy the figures satisfactorily by hand, and that he intends having them engraved on copper or steel by the machine constructed for the purpose, and will lend us the plate, so as to enable us to give our subscribers a correct copy of the figures. We have also given a set of figures as designed by Mr. Newall, of Gateshead, for the same purpose.

HACKNEY SCIENTIFIC ASSOCIATION.

At the fortnightly meeting of this Society, held on Jan. 24th, there was a large attendance of members and friends to hear a lecture by Mr. W. R. Birt, F.R.A.S., Vice-President of the Hackney Scientific Association, on "Evidences of recent Lunar Changes." The lecture was illustrated by many beautiful drawings, including some new and remarkable diagrams, projecting the curves of visibility of the spots on Plato.

Mr. Birt said that he proposed to examine the statement that "the surface of the moon had taken up its final condition myriads of ages ago." Having glanced at the well-known agencies, illumination, reflexion, visual ray, and the varying states of the earth's atmosphere, capable of effecting apparent changes in the appearance of objects, of a temporary character, he proceeded to state that, being desirous of testing the remote antiquity of the moon's surface, he had, with the assistance of several gentlemen, collected during 20 lunations as many as 1,600 observations of the 37 spots now known on the floor of the walled plain of Plato. These had in the first place been subjected to a discussion relative to their visibility, the result being that the curves of 24 spots had been projected; these curves, however, were not in accordance, a few pairs only were similar, but these pairs of similar curves appeared to indicate the operation of agencies very unlike those producing apparent change. Out of the 37 spots the curves of 9 only agreed in presenting maxima in August and September 1869. By these maxima is to be understood the fact that those particular spots were much more frequently seen in August and September 1869 than at any other times during the 20 lunations. Even the visibilities of these nine spots varied very irregularly amongst themselves, and were not similarly affected, as all the spots on an area of 60 miles in diameter ought to have been, had such agencies as illumination, &c., only affected them. Another important fact, which the lecturer pointed out, was that these spots, with two exceptions, were found on the western part of the floor of Plato. In February and March 1870, another group of eight different spots, differently situated, manifested increase of visibility. These spots were found on a band situate on the southern part of the floor, and their curves were much less in accordance than those of the first group. Another group of eight spots (but not the same) on the southern part of the floor, and extending from the E. to the W. border of Plato, manifested increased visibility in August and September 1870. These facts, the lecturer said, were irreconcilable with the principle that *all* the changes observed were only apparent, and pointed out, on a series of well-executed diagrams, the great dissimilarity which existed between the curves of certain spots, in support of his views. While, however, he laid great stress upon this dissimilarity, he called attention to the *pairs of similar curves* to which he had before alluded. The spots furnishing these curves were, he said, situated near the borders of the plain, and it was just here that the floor had been observed to dip towards the base of the mountainous wall, as if a fissure existed there, and he quoted Scrope and Hopkins to the effect, that the expansion of rock

by heat would elevate the superincumbent covering, and that when the force of tension became greater than that of cohesion, the surface would be ruptured, a system of fissures formed, and a subsidence of the disturbed tract effected. These phenomena had very probably occurred on Plato, and the similarity of the curves of the spots near the border would seem to indicate the continued operation of the agency which had produced the dip of the floor and the probably existing fissure. After alluding to the celebrated case of the crater Linné, as an example of change, the lecturer remarked, that to the opinion which seemed to be gaining ground amongst astronomers—that no change had occurred in the crater—he must demur emphatically, saying, "Not on evidence." So far as he had been able to learn, not a particle of evidence had ever been adduced to prove that Lohrmann, Beer and Mädler, and Schmidt had been in error; indeed, the whole of the evidence which had come under his notice tended to establish change. We needed, however, further observation, and although evidence of change is difficult to collect, it is not unlikely that the quiet grey plains of the moon may be found to exhibit (distance for distance) as much activity as exists at present on the earth.

At the close of this impressive lecture, listened to with the utmost interest and attention, numerous questions were put and answered, and a cordial vote of thanks was passed to the eminent lecturer.

LITERARY AND SCIENTIFIC INSTITUTE, BEDFORD.—On Thursday evening, February 2, a lecture was delivered in connection with this Society, at the Working Men's Institute, by Mr. T. G. E. Elger, on "The Physical Constitution of the Sun." As a rule, scientific lectures do not seem to present much attraction to popular audiences; but on this occasion Mr. Elger undoubtedly succeeded in throwing around his subject a charm and freshness which are generally foreign to dry philosophical details and elaborate calculations. To render his explanations more clear he had a very fine series of diagrams, prepared by himself, representing the various solar appearances,—sun spots, protuberances, spectra, &c., all of which contributed largely to the effect of the information collected in his valuable lecture. Tracing the study of the solar disc from the earliest period of observation down to the latest researches of modern science, he detailed the labours of the leading professors from the days of Galileo to the present time, explaining the several theories and entering into exhaustive analytical investigations based on the data already supplied by means of the spectroscope and other modern scientific instruments. A description of the results of various observations taken during total eclipses of the sun formed a most interesting and valuable feature in the lecture. The various phenomena observed by himself in Bedford were accurately represented on the diagrams, and his hearers were struck with the able manner in which he collected within a short space all the available facts connected with the influences exercised on magnetic currents by the solar changes. The lecture was throughout of a superior character, showing in the minutest details the deep acquaintance of the learned gentleman with his subject. A cordial vote of thanks was unanimously accorded to Mr. Elger at the close.

NEW PLANET.—A new minor planet was discovered by M. Luther at Bilk on March 12, 1871. It will be No. 113. G. F. C.

The war has stopped all continental sources of news.

ON THE DETERMINATION OF THE LOSS OF INTENSITY OF LIGHT DUE TO MOLECULAR WORK DONE IN TRAVERSING A GIVEN DISTANCE OF THE LUMINIFEROUS MEDIUM.

By Lieut. A. M. Davies, R.A.

The equation of energy being

$$m\left(\frac{dx}{dt}\cdot\frac{d^2x}{dt^2}+\frac{dy}{dt}\cdot\frac{d^2y}{dt^2}+\frac{dz}{dt}\cdot\frac{d^2z}{dt^2}\right)=x\frac{dx}{dt}+y\frac{dy}{dt}+z\frac{dz}{dt},$$

its first integral will be, if v be the velocity of the particle m,

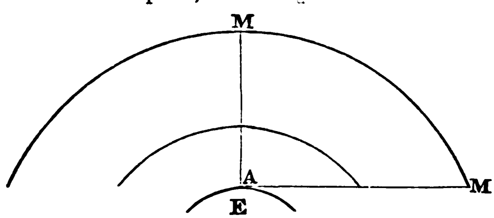
$$\tfrac{1}{2}mv^2=\int(x.dx+y.dy+z.dz)$$

$$= \text{work done by the forces.}$$

in what follows we will premise the following. *Absorption* is the loss of actual energy in doing absolute work.

Now let I be the intensity of sunlight at greatest meridian altitude, I_1 the same on horizon.

Then $I - I_1$ is the loss by absorption, and according to our enunciation is the loss due to the work done by the Sun's rays in traversing the additional depth of the earth's atmosphere,



in other words, the work done in instituting molecular disturbance in a column of air whose depth is

$$(AM_1 - AM) = f \text{ feet suppose.}$$

The mean density being the same in both and $= \delta$

Let ω be the velocity of an atom of the interstellar medium vibrating light.

Ω be the velocity of an atom of air (nitrogen and oxygen) vibrating light.

m the mass of an atom of the medium, M the mass of an atom of the air.

Then

$\int m\,\omega^2 =$ the vis viva of a cylinder of the medium reaching from the limits of the atmosphere to the sun.

$\int M\Omega^2 =$ the vis viva of a cylinder of equal section of the atmosphere whose height is the extreme height of the atmosphere under the sun's greatest meridian altitude.

$a\int M\Omega^2 =$ the vis viva of a similar cylinder measured on the horizon.

a being the ratio of AM_1 to AM. Now assuming the work done directly proportional to the loss of intensity, we have

$$(a-1)\int M\Omega^2 = I - I_1$$

Observation gives

$$I = 1300\,I_1$$

$$(a-1)\int M\Omega^2 = 1299\,I_1$$

now $(I - I_1)$ is known. Therefore

$$(a-1)\int M\Omega^2 \text{ is known.}$$

Again
$$\int m\omega^2 + \int M\Omega^2 = \frac{a\,I}{I_1}\int M\Omega^2 + \frac{I}{I_1}\int m\omega^2$$

$$(I_1 - I)\int m\omega^2 = (a\,I - I_1)\int M\Omega^2$$

$$\int m\omega^2 = \frac{a\,I - I_1}{I_1 - I}\int M\Omega^2$$

Now let the length of medium traversed be p times the length of air traversed, and let for equal lengths

$$e.\frac{m\,\omega_1^2}{2} = \frac{M\Omega_1^2}{2}$$

$$\frac{m\,\omega_1^2}{2} = \frac{M\Omega_1^2}{2\,e}$$

Where e is an assumed quantity we have to find—

$$m\,\omega_1^2 = \frac{M\Omega_1^2}{e}$$

$$\int m\omega^2 = \frac{a\left(\frac{I}{I_1}\right) - 1}{1 - \left(\frac{I}{I_1}\right)}\int M\Omega^2$$

$$= \frac{a\left(\frac{I}{I_1}\right) - 1}{1 - \left(\frac{I}{I_1}\right)}\int \frac{p}{e}\,.\,m\omega^2$$

$$\therefore\; e = \frac{p\left(a.\left(\frac{I}{I_1}\right) - 1\right)}{1 - \left(\frac{I}{I_1}\right)}$$

Now the loss of intensity due to a known length of air is given by the equation

$$(a-1)\int M\Omega^2 = I - I_1$$

and the loss of intensity through an equal length of medium is $\frac{1}{e}$ times this quantity.

The value of e has already been found in terms of known quantities, and therefore the loss of intensity due to the passage of sunlight through a particular length of the luminiferous medium is given by the equation

$$\frac{m\,\omega^2}{2} = \frac{M\Omega^2}{2\,e}$$

The late CHARLES FRODSHAM, born April 15th, 1810, was the third son of the late Mr. W. J. Frodsham, the eminent chronometer maker, who, while he devoted himself to the higher branches of his own art, took an active part in the promotion of general science, and attained the honour of admission as a fellow of the Royal Society. Mr. Charles Frodsham was brought up to his father's business, and showed in his early manhood a remarkable faculty for undertaking the more minute and intricate calculations involved in the construction and regulation of chronometers. In 1847, Mr. Frodsham was presented with the Telford Medal, for a paper on the Isochronism of the Balance Spring, which forms the second part of this volume, and was also complimented on the same occasion by being made an Associate of the Institution of Civil Engineers. In 1862, Mr. Frodsham was appointed a Juror in Class XV. in the London International Exhibition, and published a very clever and exhaustive report on "Chronometers, Watches, and Clocks." He was also in the same year the author of another treatise, entitled, "A Few Facts connected with the Elements of Clock and Watchmaking." Mr. Frodsham served twice as Master of the Clockmakers' Company. He was also appointed a Juror of the Dublin Exhibition 1865, and both as Juror and Vice-President of the Paris Exhibition in 1867. Although excluded by his position as Juror from all competition on those occasions, he gained eleven medals, among which was the grand gold medal of the Emperor of Russia. Mr. Frodsham was several times a member of the Council of the Royal Astronomical Society. He is justly entitled to take his place in the age in which he lived, as one of the most distinguished English watch, clock, and chronometer makers.

DEATH OF PROFESSOR DE MORGAN.—We are sorry to announce the death of Mr. De Morgan, which occurred on Saturday, March 18, at Camden Town. This great mathematician was son of an officer in the British army; he was born at Madura in 1806. He went to Trinity College, Cambridge, and in 1827 was 4th Wrangler; religious objections prevented his taking the degree of M.A. On leaving the University he entered Lincoln's Inn, and in 1828 was elected Professor of Mathematics in the London University. This post he resigned in 1831, but was re-elected in 1836, and held the appointment till 1866. The Professor was for 30 years a member of the Council of the Royal Astronomical Society, and for 18 years one of the Secretaries. The amount of work he got through during his useful life is simply amazing. He was the great advocate of a decimal coinage. He continued his active life almost to the end. There are few men of our day who have deserved so well of the scientific world.

THE EARTHQUAKE IN THE NORTH OF ENGLAND.—Another slight shock of earthquake has been felt in the north of England, taking a S.W. and N.E. direction. Though in some cases small articles of furniture were moved, bells rung and beds shaken to the alarm of the occupants, who fancied, in certain cases, that there was some one under the bed moving it, the shaking does not appear to have been so violent as others during this century. The effects are said to have been most severe at Ulverston and Lancaster. There seems to be no doubt that the British Isles are connected with the real earthquake regions to the south, and that a distinct movement took place on Friday 17, in that subterranean channel.

MR. HUGGINS'S OBSERVATORY at Tulse Hill has been rebuilt, and in place of the former dome of 12 feet diameter, a drum of 18 feet has been erected for the great equatorial (refractor of 15 inches, and reflector of 18

inches), by Grubb & Sons of Dublin, which has been placed in Mr. Huggins's hands by the Royal Society. At present, observations for the adjustments of the instrument only have been made.

We hear from *Nature* that one of the Temple Memorials will be an Observatory for Rugby. The telescope to be erected is Mr. Dawes' $8\frac{1}{4}$ inch by Alvan Clarke, $108\frac{3}{4}$ focal length: it is mounted equatorially, and has an excellent driving-clock; the eye-pieces range from 90 to 1,000. Other instruments for astronomy, surveying, and meteorology will be added. There is some fear lest the Masters' disputes may for a time prevent these good things from being accomplished, but we trust that the delay will not be long.

Fontenelle, the author of the celebrated work on the *Plurality of Worlds*, had nearly completed his hundredth year when he died. He expired exclaiming, "Je ne souffre pas, mes amis; mais je sens une certaine difficulté d'être."

The inscription on the monument of Leibnitz on the esplanade at Leipzig is, "Ossa Leibnitii" (the bones of Leibnitz).

James Bernoulli I., who died at Basel, after the example of Archimedes, ordered that one of his discoveries should be engraved on his tomb. It was a drawing of the logarithmic spiral, with the inscription "Eadem mutata resurgo" (changed, I rise again the same); a double allusion, first, to his hope of a resurrection; next, to the remarkable properties of the curve, well known to mathematicians, which consist in this, that many operations which in most instances convert one curve into another, in the logarithmic spiral only reproduce the original!

John Bernoulli was not distinguished for amiability. "One day he proposed to his son Daniel, then a youth, a little problem to try his strength; the boy took it with him, solved it, and came back expecting some praise from his father. *You ought to have done it on the spot*, was all the observation made, and with a tone and gesture which his son remembered to the latest day of his life."

When La Caille went to the Cape of Good Hope, in 1751, to make his catalogue of southern stars and measure a degree of the meridian, he received for his expenses, and those of a clockmaker who accompanied him, all instruments included, 10,000 francs. He remained nearly four years, and so accurately did he keep his accounts, that he was able to explain his expenditure to a sou: it was 9,144 francs and 5 sous, and he insisted on returning the balance, in spite of the disinclination of the officers of the treasury to receive it.

The early proficiency of Clairvaut in mathematics is well attested and surprising. He is said to have begun his celebrated treatise on *Curves of Double Curvature*, when only thirteen years old. It appeared when he was eighteen years of age, but was ready for the press two years before. He read the *Conic Sections* of De l'Hôpital, and also the *Infiniment Petits* of the same author, when he was only ten years old; and at the age of twelve presented a memoir on some remarkable curves to the Academy of Sciences, and removed all doubts as to its authorship by his personal explanations.

"Clairvaut and D'Alembert were rivals in their scientific labours, and though their disputes never passed the bounds of courtesy, the life of each, with respect to the other, was either armed truce or open war. The

characters of the two were essentially opposite; Clairvaut was a man of the world, of high polish, and who took great care never to offend the self-love of anyone; D'Alembert was blunt and rude, though essentially well-meaning and kind; if we may use such a colloquial phrase, he 'stood no nonsense;' 'J'aime mieux être incivil qu'ennuyé' was his avowed maxim. Clairvaut was always in the world, desirous to shine, and to unite the man of fashion with the philosopher, of all which D'Alembert was the reverse. The attacks usually came from the latter, confined entirely to the writings of his opponent; and he was frequently right, being a thinker of a more safe and cautious order than Clairvaut, who was more than once too hasty. . . The preceding comparison is drawn from Bossut (*Hist. des Math.*), who was the personal friend and the decided eulogist of both. He adds, that the polished character of Clairvaut procured him an *existence* and a consideration in the great world, which talent alone would not have sufficed to gain; and more than insinuates that dissipation destroyed his constitution."—*English Cyclopædia.*

When J. H. Lambert, the distinguished German philosopher, was a youth, he spent a great part of each night in reading such of the Roman authors as he could procure, or in studying arithmetic and geometry; the money for the purchase of the books, and even of the candles by whose light they were read, being obtained, it is said, by the sale of drawings which he found time to execute.

Assyrian Astronomy.—" Behind the harem was an enormous tower or pyramid in seven stages nearly fifty yards high. Remains of similar constructions have been found at Nimrud (Calah) and Kileh Sherghat (Elassar); and there seems no doubt that they were attached to every Assyrian palace, for the inscriptions frequently mention the one belonging to the palace at Nineveh. The seven stages, equal in height, and each one smaller in area than the one beneath it, were covered with stucco of different colours, and thus presented to view the colours consecrated to the seven heavenly bodies, the least important being at the base: white (Venus), black (Saturn), purple (Jupiter), blue (Mercury), vermilion (Mars), silver (the Moon), and gold (the Sun). This was the ancient staged pyramid of the first Semitic Chaldean Empire, adopted and but slightly modified by the Assyrians, by giving a rather smaller base and less difference between the relative sizes of the stages, so as to make it resemble rather a tower than a pyramid. But buildings of this kind, called Zikurat, and so frequently mentioned by the kings in their annals as having been erected by them, were not used in Assyria for temples, as they had been in Chaldæa under the First Empire, and as they continued to be used in Babylon down to the destruction of the city. The sanctuary crowning the summit of the Chaldæan pyramids had disappeared. The Assyrian Zikurat was simply an observatory, and on its summit the priestly astrologers, pupils of the Chaldæans, attempted to read the future in the stars. Astronomy had, in fact, quickly degenerated into astrology in Chaldæa; the belief in the direct influence of the stars on terrestrial affairs was one of the most deeply-rooted articles of faith in Babylon, and had passed into Assyria. The Ninevite kings, like those of Babylon, undertook no enterprise without first consulting the presages of the stars, and for this purpose they always had, within reach in their palaces, astrologers and an observatory. We have already seen that Sennacherib himself says that he gave up an expedition, undertaken with every chance of success, and declined a decisive battle when everything seemed to promise him a victory, because the stars did not seem favourable. We have also stated the influence that, according to the monuments, two eclipses exercised, the one on the accession of Asshurbanipal, the

other on that of Sargon. The royal astrologers kept a constant watch from the height of the Zikurat on the state of the heavens and the movements of the stars, so as to interpret them by the aid of the astrological tables so often mentioned in the inscriptions. They furnished the king with an account of their observations; and some tablets bearing reports of this kind were found in the archives of the palace of Koyundjik. As an example, one of them records the observation of the exact day of the spring equinox: 'On the 6th of the month Sivan the day and the night were equal, six double hours for the day and six double hours for the night. May Nebo and Merodach protect my lord the king.' Another, on a tablet in the British Museum, still unpublished (marked K., 86): 'To the founder of buildings, my lord the king, his humble servant, Naboiddin, chief astrologer of Nineveh. May Nebo and Merodach be propitious to the founder of buildings, my lord the king. On the 15th of the month we have observed the entry of the moon into the lunar node and the result. The moon was eclipsed.' Another, in the same collection (marked K., 78), runs thus: 'To the king, my lord, his humble servant Ishtar . . . . chief astrologer of Arbela; peace to my lord the king. May Nebo, Merodach, and Ishtar of Arbela be propitious to my lord the king. On the 29th of the month Sivan we observed the lunar node, but we have not seen the moon. The 2nd of the month Duz, in the year of Belsan, governor of the city of Hirmirdan.' It follows from this last inscription that the Assyro-Chaldæan astrologers, not able to calculate eclipses of the sun, watched attentively at each new moon to see whether one would occur."—*Ancient History of the East,* by Lenormant and Chevallier, vol. 1, pp. 463-64.

VARIABLE STARS.

Approximate times of minima and maxima of variable stars, which according to statements made by Schoenfeld and Winnecke may be expected in April.

1871.		G. M. T.						Place of star 1855.		
					A. R.			Decl.		Magn.
April	h.			h.	m.	s.		°	′	
1 ...	10·8	S Cancri	min.	8	35	39	+	19	33·2	10
2 ...		R Vulpeculae	,,	20	57	56	+	23	14·9	13
3 ...	12·7	Algol	,,							
6 ...	9·5	Algol	,,							
— ...	11·0	δ Librae	,,							
8 ...		T Cancri	,,	8	48	23	+	20	24·1	11
9 ...	6·3	Algol	,,							
— ...		R Ceti	max.	2	18	38	—	0	50·1	8
— ...		S Leonis	,,	11	3	21	+	6	14·9	9
10 ...		R Serpentis	,,	15	44	1	+	15	34·6	6
13 ...		R Tauri	,,	4	20	21	+	9	50·1	8
— ...	10·5	δ Librae	min.							
— ...		S Aquilae	,,	20	4	57	+	15	11·5	11
16 ...		S Scorpii	max.	16	9	2	—	22	31·9	9
20 ...	10·1	S Cancri	min.	8	35	39	+	19	33·2	10
— ...	10·1	δ Librae	,,							
— ...		T Capricorni	max.	21	14	0	—	15	46·4	9
23 ...		S Herculis	min.	16	45	18	+	15	11·4	12
— ...		R Aquarii	max.	23	26	19	—	16	5·3	6
25 ...		S Vulpeculae	,,	19	42	27	+	26	55·7	9
27 ...	9·6	δ Librae	min.							

THE PLANETS FOR APRIL.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	0 58 17	+ 5 39	5″·2	0 20·6
	15th	2 38 16	17 31	6″·4	1 5·3
Venus	1st	2 24 35	+ 14 26	11″·4	1 46·7
	15th	3 32 3	19 53	12″·0	1 58·9
Mars	1st	11 44 7	+ 5 11	16″·8	11 4·7
	15th	11 29 9	6 10	15″·8	9 54·7
Jupiter	1st	5 17 48	+ 22 55	34″·0	4 39·4
	13th	5 25 50	23 4	33″·0	4 0·3
Saturn	1st	18 41 47	− 22 18	15″·0	18 1·2
	15th	18 42 46	22 17	15″·6	17 7·2
Uranus	3rd	7 37 43	+ 22 5½	4″·0	6 51·1
	15th	7 38 10	22 4	4″·0	6 4·4

Mercury, during the latter part of the month, may be seen in the evening, but is not well situated for observation until the end of the month, when the planet sets about two hours after the Sun.

Venus is getting into a good position for observation; at the end of the month she sets over 3h. after sunset.

Mars is still in an excellent position, being visible till a short time before sunrise.

Jupiter is visible through the night till the 14th, after which he sets before midnight.

Saturn can be seen in the morning, and rises 2h. before sunrise at the beginning of the month, the interval increasing to over 4h. at its close.

Uranus is well worth observing.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1870.

Williams, Rev. W. O.

To April 1871.

Knobel, E. B.
Linwood, Rev. W.

To June 1871.

Freeman, D. A.
Rivaz, Miss
Williams, Prof. M.

To July 1871.

McAdam, J. V.

To December 1871.

Birmingham, J.
Hunt, G.
Lewis, R. T.
Parnell, J.
Smyth, Prof. C. P.

March 23, 1871. Subscriptions after this date in our next.

NOTICES TO CORRESPONDENTS.

The Title-page and Index to Vol. viii. are in preparation, and will shortly be delivered to Subscribers.

ASTRONOMICAL OCCURRENCES FOR APRIL 1871.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Sat	1		Sidereal Time at Mean Noon, oh. 37m. 36·9s.			Moon — 9 8·4
Sun	2		Meridian Passage of the Sun, 3m. 42·13s. after Mean Noon			9 59·1
Mon	3	11 59 12 56	Near approach of Moon to ν Virg. (4½) Conjunction of Moon and Mars, 1° 58′ S.			10 49·5
Tues	4			1st Tr. I. 2nd Oc. D. 3rd Oc. D.	12 4 12 5 12 23	11 40·1
Wed	5	2 22·8 13 21	○ Full Moon Near approach of Moon to 80 Virginis (6)	1st Oc. D.	9 20	12 31·5
Thur	6			2nd Tr. I. 1st Sh. I. 1st Tr. E. 2nd Sh. I. „ Tr. E. 1st Sh. E. 2nd Sh. E.	6 52 7 46 8 50 9 12 9 34 10 2 11 57	Mars 10 38·8
Fri	7	13 17 13 52 15 1 15 8 16 16	Near approach of Moon to ζ^1 Libræ (4) Occultation of ζ^3 Libræ (6) Reappearance of ditto Occultation of ζ^4 Libræ (6) Reappearance of ditto	1st Ec. R.	7 15 46	10 33·7
Sat	8	11 27	Occultation reappearance of ψ Ophiuchi (5)	3rd Sh. I. „ Sh. E.	7 19 10 12	10 28·7
Sun	9					10 23·7
Mon	10	13 52 20 55	Occultation reappearance of 24 Sagittarii (6) Conjunction of Moon and Saturn, 1° 20′ N.			10 18·8
Tues	11	7 51·3 9 3	☾ Moon's Last Quarter Conjunction of Neptune and the Sun			10 13·9
Wed	12		Saturn's Ring: Major Axis = 38″·32 Minor Axis = 16″·29	1st Oc. D.	11 20	10 9·0
Thur	13			1st Tr. I. 2nd Tr. I. 1st Sh. I. „ Tr. E. 2nd Sh. I. 1st Sh. E.	8 33 9 38 9 40 10 49 11 50 11 57	10 4·2
Fri	14			1st Ec. R.	9 11 27	9 59·5
Sat	15		Illuminated portion of disk of Venus = 0·854 of Mars = 0·969	2nd Ec. R. 3rd Tr. E. „ Sh. I.	9 0 48 9 41 11 19	9 54·7

DATE		h. m.	Principal Occurrences	Jupiter's Satellites	h. m. s.	Meridian Passage h. m.
Sun	16		Sidereal Time at Mean Noon, 1h. 36m. 45·2s.			9 50·0
Mon	17		Meridian passage of the Sun, 0m. 25·37s. before Mean Noon			9 45·4
Tues	18					9 40·8
Wed	19	7 3·4	● New Moon			9 36·3
Thur	20	22 37	Conjunction of Moon and Mercury, 6° 21′ N.	1st Tr. I. „ Sh. I.	10 32 11 35	9 31·8
Fri	21	0 43	Conjunction of Venus and A^1 Tauri (4m. 6) W.	1st Oc. D. „ Ec. R.	7 50 11 7 4	9 27·4
Sat	22	9 34 3 21	Near approach of Moon to B.A.C. 1361 Conjunction of Moon and Venus, 3° 38′ N.	1st Tr. E. „ Sh. E. 3rd Tr. I. 2nd Ec. R.	7 18 8 21 11 9 11 36 15	9 23·0
Sun	23	21 22	Conjunction of Moon and Jupiter, 0° 37′ N.			9 18·6
Mon	24	0 19 9 8	Conjunction of Venus and υ^1 Tauri (1m. 8) E. Conjunction of Venus and υ^1 Tauri, 0° 6′ S.			9 14·3
Tues	25					9 10·1
Wed	26	7 9	Conjunction of Moon and Uranus, 1° 17′ S.	3rd Ec. R.	8 12 37	Moon — 5 17·9
Thur	27	11 47·7	☽ Moon's First Quarter			6 8·3
Fri	28			1st Oc. D.	9 50	6 58·4
Sat	29			1st Tr. E. 2nd Oc. D. 1st Sh. E.	9 18 9 37 10 16	7 47·9
Sun	30	14 24	Conjunction of Moon and Mars, 3° 17′ S.	1st Ec. R.	7 31 26	8 37·2
May Mon	1			2nd Sh. E.	9 10	9 26·5

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN APRIL 1871.

By W. R. Birt, F.R.A.S.

Day	Supplement ☾ − ☉ Midnight	Objects to be observed
	° ′	
1	47 0	Kepler and its ray system.
2	34 29	Flamsteed, Letronne, Hippalus.
3	21 31	Sersalis, Fontana, Cavendish.
4	8 10	Region about the S. Pole.
21	155 38	Hansen, Alhazen, Oriani.
22	144 46	Burckhardt, Seminus, Messala.
23	133 58	Endymion, Warren De La Rue.*
24	123 9	Lithrow, Vitruvius, Jansen.
25	112 15	Theophilus, Cyrillus, Catharina.
26	101 12	Rhæticus, Linné, Stöfler.
27	89 54	Apennines, Aristillus, Autolycus.
28	78 17	Hell, Maginus, Moretus.
29	66 14	Laplace, Maupertius, Condamine.
30	53 45	Mare Humorum, Doppelmayer, Vitello.

The objects specified for February, p. 48, will be nearly similarly illuminated in April. The position of the terminator with regard to each may be easily ascertained from the table given on pp. 46 and 47. In April the sun will be between the winter solstice and vernal equinox, moon's N. hemisphere.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator and of 60° of northern and southern selenographic lat., where the sun's centre rises or sets.

Greenwich, midnight.	60° N.	0°	60° S.
		Sunrise:	
	°	°	°
1871. April 1	−47·3	−50·0	−52·6
2	59·5	62·1	64·8
3	71·7	74·3	76·9
4	−83·8	−86·5	−89·1
		Sunset:	
5	+78·8	+81·4	+84·0
6	66·6	69·2	71·8
7	54·4	57·0	59·6
8	42·3	44·9	47·5
9	30·1	32·7	35·3
10	18·0	20·5	23·1
11	+ 5·8	+ 8·3	+10·9
12	− 6·4	− 3·9	− 1·3
13	18·6	16·1	13·6
14	30·8	28·3	25·8
15	43·0	40·5	38·0
16	55·2	52·8	50·3
17	67·4	65·0	62·6
18	−79·6	−77·2	−74·8

* A fine formation on the same meridian west and north of Endymion. It is larger, and includes "Strabo." It is well seen as the moon passes from perigee to apogee.

SUNRISE:

1871. April 20	...	+80°·7	...	+78°·4	...	+76°·0	
21	...	68·5	...	66·1	...	63·8	
22	...	56·2	...	53·9	...	51·6	
23	...	44·0	...	41·7	...	39·3	
24	...	31·8	...	29·5	...	27·2	
25	...	19·5	...	17·2	...	15·0	
26	...	+ 7·3	...	+ 5·0	...	+ 2·8	
27	...	− 5·0	...	− 7·2	...	− 9·4	
28	...	17·2	...	19·4	...	21·6	
29	...	29·4	...	31·6	...	33·7	
30	...	−41·6	...	−43·8	...	−45·9	M.

MARS.

Areographic longitude and latitude of apparent centre of disk, angle of position of axis, diameter, and amount and angle of position of greatest defect of illumination.

1871.	Longitude. 8h.	10h.	12h.	Lat. °	Axis. Gr. midnight.	Diam.	Def. of ill.	
April 1	254°	283°	313°	25·6 N.	26°·0	14·12″	0·12″	123°
2	245	275	304	25·6	25·8	14·08	·14	122
3	237	266	295	25·7	25·6	14·03	·16	122
4	228	257	286	25·7	25·4	13·98	·18	121
5	219	248	278	25·8	25·2	13·93	·20	121
6	210	239	269	25·8	25·1	13·87	·22	120
7	202	231	260	25·9	24·9	13·81	·24	120
8	193	222	251	25·9	24·7	13·75	·26	119
9	184	213	243	26·0	24·6	13·69	·28	119
10	175	204	234	26·0	24·4	13·62	·31	119
11	166	196	225	26·0	24·3	13·55	·34	118
12	157	187	216	26·1	24·1	13·47	·36	118
13	149	178	207	26·1	24·0	13·40	·38	118
14	140	169	198	26·2	23·9	13·32	·40	117
15	131	160	189	26·2	23·8	13·24	·43	117
16	122	151	180	26·3	23·6	13·16	·46	117
17	113	142	171	26·3	23·5	13·08	·48	117
18	104	133	163	26·4	23·4	12·99	·50	116
19	95	124	154	26·4	23·3	12·91	·52	116
20	86	115	145	26·5	23·3	12·82	·54	116
21	77	106	136	26·5	23·2	12·73	·57	116
22	68	97	127	26·5	23·1	12·64	·59	116
23	59	88	118	26·6	23·1	12·56	·61	115
24	50	79	109	26·6	23·0	12·47	·63	115
25	41	70	100	26·7	23·0	12·37	·65	115
26	32	61	91	26·7	23·0	12·28	·67	115
27	23	52	81	26·8	22·9	12·19	·69	115
28	14	43	72	26·8	22·9	12·10	·71	115
29	5	34	63	26·8	22·9	12·01	·73	115
30	356	25	54	26·9 N.	22·9	11·92	0·75	115

THE CENTENARY NUMBER OF THE ASTRONOMICAL REGISTER.

In the open air this evening, the 23rd of March 1871, about seven o'clock, we gazed with all our old delight on the lovely sky. In the East, Mars, red and fiery, was rising. How different to all other objects in the heavens! no wonder the ancients gave him the title applicable to the God of Battles. High above, almost in the zenith, appeared the twins Castor and Pollux, and a little to the West the glorious Jupiter. Below the lovely constellation Orion, and the incomparable Sirius, shone in all its beauty Betelgeuze, and the adjacent Aldebaran shining with similar lustre. We can scarce spare a glance for the misty Pleiades, for there in all their glory are the young moon and Venus. Dazzling the eye in the bright twilight, in which like glorious gems they reign supreme, who could look upon such a wondrous scene without a wish rising to possess more knowledge of the sublime science which treats of them? Can we wonder that the ancients persevered until they became acquainted with so much of the captivating study? It was some such thoughts as these that originated the commencement, more than eight years ago, of our little periodical, intended to assist beginners at the commencement, and to interest them during the progress of their study of astronomy. Since that time numberless scientific serials have arisen, blazed into light, and sunk to rise no more; while our little *Register* has pertinaciously held its way in spite of many adverse circumstances. But when we recall the pleasure we have had in carrying on the *Register*, and the memory of the kind friends who assisted us in its commencement (many, alas! now no more), we do not consider our time and labour wasted. And for the future, if it be considered and admitted that the *Register* does not and cannot depend, like popular periodicals, on a large circulation, that it must be supported by the free contributions and correspondence of the subscribers, and by each one assisting to increase its circulation—under these circumstances it is to be hoped that it may still continue to be of use to those to whom we may be permitted to flatter ourselves it has hitherto proved acceptable. We will not further take up space wanted for more important matters, but we could not resist the temptation of saying a few words on the occasion of our Hundredth Number.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 101. MAY. 1871.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Sixth Meeting, April 14th, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. Thirty-six presents were announced, and the thanks of the Society given to the respective donors.

Charles Coppock, Esq.,
Capt. W. M. Campbell, R.E., and
James W. Lee Glaisher, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Extract from a letter of the Rev. W. A. Jevons, on the Zodiacal Light: communicated by Mr. Rees.

On Good Friday, about 7h. 4m. in the evening, the writer thinks he saw the zodiacal light. He was at Buxton, and observed a luminous appearance a little north of the place where the sun had set. It was nearly perpendicular: about 1° broad, 5° high, and lasted about 5 minutes.

Mr. Birt observed it on the same evening, but it was much longer. It extended from Aldebaran to ϵ Persei; the apex was very rounded, and terminated near τ Tauri. He saw it again the following Monday.

Mr. Penrose had seen it several evenings in March with

considerable distinctness. It was of the same colour as the Milky Way, and on one occasion decidedly brighter.

Messrs. Birt and Penrose both agreed that the Pleiades were quite involved in the luminosity.

Dr. Mann suggested that what Mr. Jevons saw might have been a streamer of an aurora, as the dimensions were so small, and that the obtuseness of the apex in the zodiacal light was due to the amount of twilight, which would blunt the point of the ellipse.

The President remarked that at Malta, where he had seen it very much better than in England, the colour was ruddy.

On a remarkable appearance during the Solar Eclipse of December 22nd, 1870: by Commander Hardy.

The writer has seen no account published of a singular appearance noticed by himself and the Rev. H. Winwood, at Bath. On the day in question the sky was covered with broken clouds, which did not however interrupt the observation of the eclipse. Some time before the greatest phase, a large and brilliantly coloured patch of light was seen about 15° to the east of the sun. The colours were green, purple, and orange, but green predominated. Soon after the greatest obscuration the tints faded, and clouds obscured both the patch and the eclipse.

The President said that it had been suggested by Mr. Main that the writer had probably seen a mock sun, and this appeared a very good explanation.

On the Orbits of the Revolving Double Stars ζ Hercules and ζ Cancri: by Mr. Plummer.

The author states that several attempts have been made to determine these orbits, but the assumed positions have not agreed with these angles as observed subsequently. The latest of ζ Hercules is by Mr. Breen, but there is still discrepancy in position. He (Mr. P.) has therefore made another trial by equations of condition founded on the most recent observations, and obtained elements which satisfy them, from which he has computed an ephemeris from 1870 to 1875, which will test his results. He makes the periastrum in 1866, when the distance was 0·241″, the period 36·06 years, and the mean distance 1·374″. In the determination of the orbit of ζ Cancri he has used the elements of Dr. Winnecke, but the distances show considerable discrepancies. The periastrum he finds will be in 1872, with a distance of 0·44″, the period 58·23 years, and the mean distance 0·908″.

Observations on the Planet Amalthea (113); by Dr. Luther.

Calculations to obtain the Earth's Exact Distance from the Sun and Moon, &c: by Mr. Dingle.

Observations and Elements of Winnecke's Comet: by Mr. Hind.

A small comet having been discovered by Dr. Winnecke in Perseus, it was detected at Mr. Bishop's Observatory on April 10. The place was then R.A. 2h. 41m. 40s., and N.D. 52° 26′, with a daily motion of 5 minutes in R.A. and 30′ in N.P.D. There is an extension of nebulosity on the side farthest from the sun, so that a tail may be expected. A good telescope is required to see it. This comet does not seem to be an appearance of any one formerly known. Its perihelion will be June, 1871.

Dr. Huggins had seen it last night. It was very faint indeed, but had distinct indications of a tail. It was just visible in the finder of his large telescope. This finder is of 4 inches aperture. [Dr. H. made a sketch of the comet.]

Letter to Mr. Carrington, on Spectroscopic Observations: by M. Chacornac.

This communication suggested that the line D was a phenomenon of interference due to the jaws of the slit.

Dr. Huggins said that the papers being exhausted, he would hand round a series of drawings of Jupiter he made and presented to the Society about ten years ago. They extended through the years 1858-9 and 60, and were accompanied by a note suggesting that if there were periodic changes in configuration or colour, they would be useful for comparison. One only was coloured, but it might be understood the others had similar tints.

Mr. Carpenter said he had been observing Jupiter with the great Equatorial at Greenwich, and had long been familiar with the reddish colour of the central band. In 1861-2 he made 40 or 50 drawings of the planet, and this colour was then strong. There was a gap in the drawings from that time to 1868, but he was sure that, had any change taken place in the tint, it would have been remarked.

The President had been an observer of Jupiter for a quarter of a century, with telescopes ranging from a 7-inch Gregorian to very large reflectors. He had seen minute white specks, and large round spots on the belts at various times, but these were very ephemereal. With the same telescopes now, and recalling his first impressions, he found the planet about the same as in his early days. Any changes, he thought, were not chronic but cyclonic. His general impression of its form and colour was the same.

Dr. Huggins: When the belts are more distinct at one time than another, of course the colour appears stronger. I do not detect any changes of colour. It appears almost identical with what I saw when my drawings were made.

Mr. Ranyard: Several distinguished observers have thought

the colour has changed. Sir Wm. Herschel speaks of it as russet. Mr. Dawes, in 1859, thought Jupiter had altered considerably in colour. Whether the bright egg-shaped spots are always to be seen on the belts, I do not know; but they are most conspicuous now, and are so in Dr. Huggins's sketches. Mr. Dawes saw the smaller white markings, which are the same as in these drawings before us. The central belts have always the same character, but the very small spots occur only on the polar belts.

The President: What I saw were small, round, white spots, like satellites.

Dr. De La Rue: I have observed and made drawings of Jupiter for twenty years, and my experience goes to confirm what has fallen from the President's lips. The colour is one of the earliest things which strikes an observer. It is ruddy in the central bands, and at once forces itself upon the attention. It is found in my drawings. It varies a little, but is not essentially different to what it was twenty years ago. Some persons who begin with small telescopes, which do not display the colouring when they see it with larger instruments, think the planet has changed. There are sometimes great changes in the form of the belts, but in time the configurations recur. There is a great deal of colour in Saturn, Venus, and Jupiter, and more attention is paid to this now than formerly.

The President: Has Mr. Ranyard obtained any evidence of periodic changes?

Mr. Ranyard: There are twenty-six observations of spots, of which three only are stated to be white. These occur within twelve months of the maximum of sun spots. Sir Wm. Herschel's observations of the colour agree with the sun-spot maximum. The black spots do not agree at all with this period. I have no strong evidence at present, but think that the egg-shaped and Dawes's spots coincide with the sun-spot maximum.

The President: Such observations should be continued.

Mr. Ranyard: The broken belts are more frequent lately. They seem to be connected with the sun-spot period.

Mr. Carrington: There is no such connection between sun spots and Jupiter's markings.

Col. Strange: It occurs to me that colour is one of the last things to be trusted. There are four things noticed by the eye—size, form, luminosity, and colour. Of these four the permanence of impression as to colour is least reliable. More persons carry away correct impressions of the other three than of colour. Let any one look at the paper of a room, and go to a paper-warehouse to try and match it, and he will bring home a very bad one. I made this experiment myself lately. Eyes differ so much in

estimation of colour that no two should be trusted for comparison unless they have been properly tested. The same eye also differs at different periods of life. The heavenly bodies are much affected by atmospheric conditions, and the observer by conditions of health and other circumstances, so that, unless the evidence were overwhelming, I should not trust to any statements of colour.

Mr. Penrose: I agree as to form being better remembered, but there is a respectable minority I would trust as to colour, especially artists and those who have bestowed great attention on the subject. I admit there is great diversity in eyes, but the same eye and the same object used for many years gives a reliable result. With the same telescope I find Jupiter is not so coloured this year as last, but this may be due to atmospheric changes.

Dr. Huggins: With respect to Mr. Ranyard's remarks, it should be remembered that telescopes have much improved in character during the two or three last sun-spot periods. The telescopes generally used are two or three times as large as those formerly available by the majority of observers, and therefore small spots may be expected to be seen oftener.

Mr. Ranyard: Yet black spots were frequently noticed by the very old observers, such as Cassini and others.

The President: But the minute white spots are much more difficult.

Dr. De La Rue desired to recall the attention of the meeting to another subject—one at which he had worked ardently himself, and was therefore qualified to appreciate devotion to it in others. There happened to be present in the room a gentleman to whose labours in astronomical photography they owed the beautiful pictures of the moon which adorned the walls. He meant Mr. Rutherfurd, of New York. [This announcement was received with great applause.]

Mr. Rutherfurd said, he was not prepared for such a flattering reception, but he had in his pocket a few photographic plates, which he wished to present to the Society. The first was a negative of the sun. This was taken with a refracting telescope, corrected for the actinic rays, and not for vision. He had spent many years over the adaptation of photography to the celestial bodies. His first expedient to get the chemical rays to a focus was by interposing a lens between the object-glass and the sensitive plate; but he found that this only produced correction in the centre of the picture, and that the edges were confused. About ten years ago, when the discoveries of Kirchhoff and Bunsen were made known, he applied a spectroscope to the stars, and found this gave him an unerring test of the state of the

corrections of his telescope and the means of completing such correction. He would explain this by a diagram. If all the rays from a star converged to a focus, that would be a point; and if that point were received on a prism, it became a line, with one end red and the other violet; but if the rays had not met at one point, the spectrum would be not a line, but a brush. An inspection, therefore, of the lines of the spectrum showed which were not parallel, and he was enabled to correct any out-standing errors, till he got his spectrum of the proper character. A moment's inspection of the spectrum of Sirius or α Lyræ (other stars did not give light enough) now enabled him to correct his telescope. Having corrected the object glass for colour, the next point was the figure. Mathematical calculations would give the formulæ, but these could not be carried out directly. The only means available was a tentative process. He, therefore, had to mount his telescope with great accuracy, and get his clock to carry it six or eight minutes quite steadily. He then took numerous pictures in and out of focus, and comparing their defects and making alterations, at last corrected his object-glass to his satisfaction. He then proceeded to work. His object was not only to obtain pictures of the moon, such as those presented by Mr. Buckingham, but to make the stars record their own position for all time. He attacked the *Pleiades* first. His plan was to take a plate and expose it to the stars for several minutes, during which the clock worked most accurately. The light was then shut off, and another picture taken to identify the stars, and thus see which were stars and which were pin-holes, which so annoyed photographers generally. The clock was then thrown out of gear, and each star then made a track along the plate, forming a base line, by which positions could be most accurately measured. One of his plates of the Pleiades he presented to the Society. [The stars were wonderfully sharp in this negative.] He had found that the greatest amount of sensibility of the plates was secured by exposing them to a little light before insertion in the apparatus—just sufficient to produce a slight fogging if then developed. The chemicals seemed to be in a very unstable state of equilibrium, and this induced a commencement of action which was carried on by the stars. As to the sun, he used a camera body, attached to the telescope, with a stop at the point in the cone of rays, where it was only $\frac{1}{10}$th of an inch in diameter. The effect of a narrow line in his slide was, however, to produce distortion. He then tried slower chemicals and a larger aperture. Dry plates gave the best results, but there were many difficulties in their use, and he had now returned to the ordinary wet ones. In his experiments to avoid distortion, he had used ruled plates

to measure spaces in different parts, and could readily detect what distortion had been produced. He had done all in his power to ensure correct results. He had discarded the wooden tube of the telescope, which played all sorts of vagaries, and he used now a galvanized iron one, which was ugly but worked well. It must be remembered that you could not focus on the plate by the eye, so that after having found out by experiment the right point of focus at a certain temperature, he placed thermometers all along the tube, and made the necessary allowance in focal length for any other temperature. The tube was a closed one, but there were three ventilating openings in it. If the observatory were very hot, these were opened, and the telescope left till the temperature inside and out became uniform. The plate for photographing the stars must be properly collimated, or the measures would be wrong. To do this he covered a plate all but the centre, and also the object-glass; and then, if the image of the flame of a candle projected by the object-glass on the plate were perfect, there would be no distortion of half a hundredth of an inch. Having obtained his photographs, the next thing was to utilize them; and for this purpose a micrometer was required. Had he known the one invented by Dr. De La Rue, for measuring the solar photographs, it would have saved him much trouble, but not being aware of it, he constructed one having a divided circle, and a glass stage above it, on which the photograph was placed. Then a compound microscope, carried by a sort of slide-rest, and worked by a very delicate screw, made the measures. The results were excellent, and superior to those of Bessel's heliometer. He instructed a lady to make these measures, and found her quite competent for the work. Ten measures were taken of each position. Dr. Gould had reduced some of the results, and found them very flattering to the method. He (Dr. Gould) stated that one plate was equal to a year's observations by the eye in the usual manner. These observations had not yet been published. In the course of some years' work the micrometer screw had become worn, and the error had increased lately. It would be possible to introduce an average correction for each year, but he had now discarded the screw, and remodelled the instrument on Dr. De La Rue's plan, using a sort of straight-edge slide. It was necessary to find the value of the screw. One method which was first tried was very fascinating, but did not give such good results as others. It depended on a screen or fan placed between the object-glass and the plate, and being moved rapidly by clock-work, had its motion stopped every second by the sidereal clock. The telescope being placed on a star near the meridian, the plate received a succession of pictures

of the star, and from its motion in a second the value of the intervals could be deduced. An exposure of several minutes gave better results than an instantaneous one. Another plan was arranged with Dr. Gould, by taking pairs of stars having nearly the same declination. Dr. Gould recorded the transits with his large instrument, and Mr. Rutherfurd took pictures of the same pairs, which were afterwards compared. The best result was, however, obtained by taking transits of stars upon plates having lines ruled in different parts. In this operation the aperture was reduced to two inches. With respect to moon photographs, he would mention that by mounting two pictures, so that they could be revolved, he found that in one position they gave a stereoscopic effect; and in another, a pseudoscopic one, looking like a picture in a crystal basin. This slide he would leave with the Society. [Cheers.]*

The President said he was sure all present would join him in recording their grateful thanks to Mr. Rutherfurd for his admirable account of the progess made in adapting photography to practical astronomy.

Dr. De La Rue: Our visitor's efforts have been directed, not merely to produce fine pictures of the moon, but to furnish astronomers with unerring records by which to test future progress and astronomical changes. Our great enemy in photographic operations is the atmosphere. Other difficulties can be overcome, but this continually beats us. I am in hopes that photography will some day settle the question of the *physical libration* of the moon—that is, whether there is any real balancing or swinging to and fro. The other librations can be allowed for; and the one in question, if existing, I believe will be detected. The angular diameter of the sun is another matter more amenable to photographic measures; and they should, I think, be greatly preferred to those made with ordinary instruments. Allowance can be made for any little optical distortion; and I expect the ten years' Kew observations will throw light on this subject. The sun's diameter may not be always the same. The prominences are known to be in a state of constant alteration as to height, and the mobile photosphere may do the same. The effect of distortion by the lens was obtained at Kew by placing objects on the Pagoda there, and photographing them on different parts of the plate in the way I have described on a former occasion. I feel sure that astronomical photography has only to be

* The above is but a sketch of Mr. Rutherfurd's lucid and interesting explanation of his processes, which was so constantly illustrated by diagrams he made, as he proceeded, that further detail without these would be unintelligible.

pursued steadily to achieve far greater results than have hitherto been obtained, and has a brilliant future before it; and I desire to record my admiration of Mr. Rutherfurd's most successful labours.

Mr. Rutherfurd said, Dr. De la Rue had prophesied a hopeful future for photography, which he trusted to find realised. He should like to mention that the pictures of the moon were taken with an object-glass of 11½ inches aperture, specially corrected for the chemical rays, but he now used an ordinary achromatic of 13 inches aperture, which could be converted into a photographic lens in five minutes, by slipping a meniscus of flint glass in front of it. This altered the focal length, for which arrangements were made at the tail-piece. He would also remark that the outline of the moon on the circular side was not uniform. His friend at the head of the United States Coast Survey, was very fond of occultations for determining longitudes, but found discrepancies on this account, and he (Mr. R.) photographed the moon on many of these occasions, and could see the minute deviations in outline. The sun's outline looked sharp and clean, but that of the moon was not so. In the American photographs of the eclipse of 1869, she did not look perfectly round on the sun's disk. The dimensions of the sun were different according to the time of exposure. The light fell off so rapidly towards the edges, that there might not be time to produce a complete image. If pictures were taken with different apertures, it would be found that the greater gave diameters many seconds larger than the small. This might account for the differences noticed in observations of the transits of Venus and Mercury.

M. Jansen was also present at the meeting, and at the President's request, gave an account of his attempt to observe the late Solar eclipse in Algeria, and made some remarks on the nature of the corona.

The meeting then adjourned.

THE INDIAN ZENITH SECTOR.

Sir,—I trust you will afford me a little space to make a few observations and explanations with respect to Captain Herschel's letter on the above subject. The letter speaks of the "extraordinary mistakes," and "unmeaning extracts," contained in the report of Colonel Strange's paper, brought before the November Meeting of the Royal Astronomical Society, as printed in your periodical, for which I am responsible; and I hope to show that, so far as my share of the matter is concerned, such language is hardly justifiable. It is probable that Captain Herschel and many of your readers are not aware of the difficulties under which

reporting is carried on at Somerset House. The Society makes no provision for the accommodation of reporters, who have therefore to work with note-book in hand, and without sufficient elbow room. They have no access to the papers, and are entirely at the mercy of the secretary or author who may read a paper, as to how much he thinks proper to give, and it is obvious that of this portion only can any abstract be communicated to the public in your journal. As a rule, therefore, all that can be done, is to give a general idea of the contents of the papers, which, as they are subsequently printed in *The Monthly Notices*, are seen *in extenso* by all interested in the subjects; while every effort is made to report the discussions as fully as possible, as the observations then made, which are often more valuable than the papers that originate them, would otherwise be entirely lost. It should also be mentioned that the paper by Colonel Strange came on at a late hour of the evening (in fact it was the last paper), and the author, instead of reading it, gave an oral synopsis of its contents, and did not even read the extracts the paper contains from Captain Herschel's letter, but merely quoted the leading points from memory, aided by an occasional glance at the MS. He is so careful and deliberate a speaker, and so easily followed, although I do not write shorthand, that I think I may safely say that anything I find upon my notes was actually said, although it may not be the *whole* of what was said. With these preliminary observations, I proceed to notice Captain Herschel's paragraphs in detail.

1. There is evidently a mistake here as to Captain Herschel having measured a base line at the dates mentioned, but the operation was certainly referred to by the speaker. The dates given appear to be the beginning and ending of the letter, but it is commenced at "Coimbatore Base," and the speaker may have casually indicated that his correspondent was so engaged. However, as Captain Herschel remarks, his engagements at the moment have nothing whatever to do with the subject of his letter.

2. I find the word "closing" so distinctly written in my notes, and another word struck out in its favour, that I can hardly doubt it was really uttered. It is certainly printed "choosing" in *the Monthly Notices*, but as the paper also goes on to mention the "twenty-four distinct operations, consisting of settings, readings, intersections, and reversals," which I also reported as having to be done in the five minutes allowed, I cannot but think "closing" might have been used by Colonel Strange as more expressive of the work to be done in the time than the "choosing" of the writer of the letter, which to most persons would hardly seem to include actual observations with the instrument.

Paragraphs 3, 4, 5, 6, and 7, admit the accuracy of my report of the expressions used as far as given, but supplement them by important explanations. As to paragraph 5, I find that the word "generally" was used in stating the errors of each triplet were within 1″. The additions by Captain Herschel are doubtless most valuable, but as they were not read at the meeting, I had no means of including them in the report, the official publication of the paper not taking place till long after the *Astronomical Register* is out. It will be seen that Colonel Strange gave some illustrations of the accuracy of the division of the circles, which are his own calculations, and not included in Captain Herschel's letter or the paper as printed; and he also made other remarks not in his paper, showing that he spoke extempore, and did not read exactly what he had written; and the presumption therefore is, that I noted what he did really say, and could do no more without seeing the paper.

However, I think it fortunate for the readers of the *Register* that Captain Herschel has been induced to add his interesting and important explanations to the report, for which they cannot but feel most grateful; and I trust that they will also allow that the account of the paper is as good as possible under the difficult circumstances attending its communication experienced by

April 14, 1871. YOUR REPORTER.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

RIGHT ASCENSION OF URANUS.

Sir,—Perhaps it may interest some of your readers to know the amount of difference between the observed and tabular right ascension of Uranus, as other observers besides Capt. Noble may have been disappointed to find that at the occultation of March 2, the planet had disappeared some minutes before the calculated time. At the meeting of the Royal Astronomical Society, on March 10, I mentioned that the true right ascension of Uranus was about 15 seconds less than that given in the *Nautical Almanac;* and that consequently the disappearance must naturally have taken place some minutes before the time obtained direct from the tables. In the abstract of the proceedings of the Society, contained in the April number of the *Register*, this difference is wrongly printed, 15 seconds of arc, instead of 15 seconds of time, which may probably mislead some one.

The following numbers are the differences between the observed right ascension and that inserted in the *Nautical Almanac.* The sign + signifies that the tabular place is too great.

Year.	Tabular R.A.—Observed R.A.
	s.
1867	+ 15·6
1868	15·4
1869	14·9
1870	14·4
1871	+ 13·8

On March 2, 1871, at 15h. M.T., the increase of the Moon's right ascension in one minute was 2·27s. As the true right ascension of Uranus was nearly 14 seconds less than the *N. A.* right ascension, the true time of disappearance at the Moon's limb would be about six minutes before the calculated time—an interval quite sufficient to cause the disappointment felt by observers after sitting up to so late an hour.

The only tables available for the calculation of the tabular places of Uranus, are those of Bouvard, published at Paris so far back as 1821.

I am, Sir, your obedient servant,

EDWIN DUNKIN.

April 6, 1871.

MOCK SUNS AND MOONS.

Sir,—The Rev. T. W. Webb, in his letter in the *Register* for March, referring to the above subject, states: "*A season of frequency may possibly now have commenced, and many of your readers may be interested in keeping watch for both solar and lunar appendages of this nature.*" Since his reply to my letter, I have been looking out for this interesting phenomenon; and on April 6th I had the pleasure of witnessing both. At half-past 5 o'clock in the evening, the sun was surrounded with a halo about 70° in diameter, the lower part of which was hid below the horizon. There was a vertical strip of white light proceeding from the upper and lower limb of the sun. On the northern side of the sun, on the halo, appeared a parhelion, which lasted a quarter of an hour. At 6 o'clock a brilliant parhelion appeared on the upper part of the halo where the white strip of light terminated. Its form was nearly circular, and its apparent diameter a little greater than that of the true sun; two beams of light shot out from the upper part of the parhelion at angles of 45°. This beautiful phenomena continued above half an hour. I drew the attention of a farm-labourer to this phenomena, and he stated, "This is what I have not seen for many years. Those bright spots on the ring we call *sun galls*, and when they appear afar off rain will soon come."

The same evening, at 8 o'clock, a halo appearance around the moon about 50° in diameter, and paraselenæ appeared on the halo on the southern side of the moon, but was not very bright. A vertical strip of white light proceeded from the upper and lower limb of the moon also.

Yours respectfully,
J. WEBB.

Wiveliscombe, Somerset:
April 8, 1871.

DARWINISM AND ASTRONOMY.

To the Editor of the *Times*.

Sir,—After the many solid arguments adduced in your late admirable and most welcome notice of Mr. Charles Darwin's recent work, I should like to make only one suggestion. Mr. Darwin's theory requires us to believe that animal life existed on this globe at a period when, according to a theory much more plausible than his, the earth and all the planets with the sun constituted but one diffused nebula. Astronomers really have some *data* on which to found this theory of theirs, since marked variations in the conformation of several nebulæ within historic times are now on record; whereas all the variations which Mr. Darwin has been able to point out in species, and especially in man, within the same limits of time are either zero, or of an extremely nebulous character.

I remain, Sir, yours faithfully,
ASTRONOMICUS.

April 10.

THE ROYAL SOCIETY'S NEW TELESCOPE.

Daily Telegraph, 14th April.

The pursuit of science is rapidly passing out of the range of private resources. For many of the more important branches of research, the instrumental and material requirements are beyond the supplying powers of individual purses. This is especially true of astronomical investiga-

tions, which, to be carried on nowadays with any hope of valuable results, necessitates the employment of telescopes, the fabrication of which involves the outlay of little fortunes. Time was when four or five hundred pounds would give an astronomer a telescope and appurtenances with which he might hope to advance the science of his adoption. But now, although much useful work remains to be done with such comparatively moderate instruments as can be purchased for the sum just named, he who desires to open new and wider fields of celestial study must be prepared to pay in thousands for the optical key. To give an idea of the value of great telescopes, we may mention that the large refractor added a few years back to the Greenwich Observatory, cost, with all its complexities of mounting, a sum exceeding ten thousand pounds, and that half this sum was recently paid by the Government of Victoria for a reflector of 4-feet aperture that has been set up at Melbourne.

In view of the fore-mentioned circumstances, it will be acknowledged that the Royal Society did a wise thing in devoting a legacy that lately fell to it, to the purchase of a large astronomical telescope, to be placed at the service of some ardent amateur, competent to use such an instrument to the best advantage. The bequest alluded to was a sum of 1,500*l.* left by the late Benjamin Oliveira, to be expended upon such a scientific object as the Council of the Society should deem worthy and appropriate. The suggestion for its astronomical dedication came from Dr. Robinson, the well-known astronomer of Armagh, and in adopting his proposal, the Society made up the sum to 2,000*l.* Estimates were sought from several English and Continental instrument makers, and the result was that the work of constructing the telescope went into the hands of Mr. Grubb, of Dublin, who was then completing the large reflector for the Melbourne Observatory, to which we have just made allusion.

The telescope decided upon and now completed is an equatorial refractor. The size of the object-glass, 15 inches, is imposing. Until within the past two or three years, there were but two glasses of such a size in the world; one was at the Russian Observatory at Pulkova, the other was in the United States, at Harvard College. Lately, however, attempts have been made to surpass considerably this diameter, Mr Cooke, of York, having, at a great cost—borne by Mr. Newall, of Gateshead—attempted and accomplished the working of an achromatic lens 25 inches in diameter, and Mr. Buckingham having recently made one of 21 inches diameter. As yet we have heard of no trials of these glasses which could determine how far the inconceivable difficulties of figuring larger lenses have been overcome.

The Royal Society's object-glass is remarkable for the shortness of its focus, which is only 15 feet. The design of this shortening is to secure great concentration of light—a principal intended use of the instrument being for the spectroscopic analysis of the light of the fainter stars and nebulæ. By the large area of the lens, a great amount of light from any object under view will be grasped, and by its shortness of focus that great amount will be condensed upon a very small space, and thus great brilliancy will be secured in objects of sensible size, like planets or nebulæ; for stars it is of no importance, since a star appears but as a point in any telescope. Every schoolboy knows that the burning-glass which acts best is a large one that has a short focus, and that, consequently, gives a small and intensely brilliant image of the sun. The concentration that the schoolboy wants for sport the spectroscopist requires for science.

During the discussion upon the telescope, and before its construction was actually decided upon, the question naturally arose, into whose hands

should it be placed? Considering that the branch that at the present time requires the greatest fostering, and promises the grandest results in return, is the new science of spectrum analysis, it was quite natural that the first thoughts of the initiators should be turned to the father of spectroscopy, Dr. Huggins, to whom astronomy is indebted for advances comparable in importance to those that have made the name of Herschel immortal. To him, accordingly, the telescope was spontaneously offered. A wiser offer could not possibly have been made, and it was curiously well-timed, for Dr. Huggins was then concluding an engagement with a maker for the purchase, at his private cost, of a large instrument to replace the one of 8-inches aperture, with which his high reputation has been earned. He accepted the Royal Society's offer, upon the conditions that he should retain the instrument during the time he might be willing to devote it to spectroscopic or other astronomical researches, and that he should be free to select working subjects of his own choice. His well-known zeal and character were guarantees that the best possible use would be made of it. He thus became a party to the construction. He decided upon plans and details, and forthwith erected an observatory to receive it, at an outlay of about 500*l.*, and within the past few weeks it has been duly installed therein. We have had an opportunity of inspecting it, and of judging upon the optical performance of its object-glass. To say that the instrument is mounted with high engineering skill, that it possesses great stability, with such an ease of motion that a child could with one hand direct it to any part of the sky, that it has a competent driving clock, and all the perfect minutiæ that experience could suggest, is but to state matters of course. Technical details would be out of place here. The containing dome, with its shutters opening for view of any part of the heavens, has been constructed with some taste, and with conditions of comfort that many an astronomer who visits Dr. Huggins will envy. But who should be comfortable if not he who resigns the blandishments of the dormitory for science's sake?

Upon the night of our visit, the atmosphere, although very clear, was a bad one for astronomical observing. An east wind was blowing, and, as usual under such circumstances, the air was so unsteady that the delicate tests of a telescope's powers—the visual separation of close double stars—could not be resorted to. We saw enough, however, to give us a favourable opinion of the telescope's optical excellence, and we doubt not that it will do a great deal towards wresting from the makers of Munich the palm which they have held for years, on account of the superiority of their object-glasses.

To add to the completeness of the instrument as a whole, it has been furnished with a speculum of 18-inches aperture, forming a reflecting telescope of the Cassegrain form, which can at pleasure be mounted in the refractor tube. The reflector may come into use when it is desired to make certain observations, such as those of the amount of heat radiated from the moon, or from stars which would be affected detrimentally by the passage of the rays from the moon or star, through a lens-glass having the property of intercepting feeble rays of heat.

It would be premature to speak of the results to be anticipated from this instrument. Suffice it to say that Dr. Huggins proposes to pursue systematically and vigorously his spectroscopic researches, upon the stars and nebulæ; and, if ends grow with means, we may expect grand results indeed.

AURORA BOREALIS.

On Sunday, April 9, another magnificent display of aurora took place. Its arc, W.N.W. to N.E., was much lower than in the former displays; but the intensity of the crimson light was far greater. Crossing this light and extending to the constellation of the Great Bear, were beautiful streamers of a fine green colour: these did not form so distinct an umbrella-shaped corona as culminated above Cygnus last year, but the lines were much more distinct and more highly coloured. We watched it from 10·30 to 12·15: at about 11·30 the crimson colour disappeared, and a flood of white light continued to shoot out, at times not unlike a gigantic comet. Soon after 12, it went off. It is not unworthy of notice that the direction of the aurora was identical with that of a semi-transparent line of light clouds. The intensity of the red may be gathered from the fact that all but the largest stars were from time to time obscured. Procyon was distinctly coloured by it. Jupiter alone stood out, with his pure silver light, and a very lovely object he was. By the following extracts it will be seen that at Leeds and other places the red light continued longer than in London:—

Times, April 11.

At 9 p.m. the north horizon appeared preternaturally luminous, and some faint streamers were sent up from an arc that existed between two dark homogeneous cloud modifications. This incipient phenomenon lasted about half an hour. At 9·30, the whole north was illumined by a bright white light. At 10, the western portion became luminous, and sent up long lines of streamers of surpassing beauty. Some were of dazzling whiteness, and interspersed with them were others of rose-pink, that were projected beyond and below the zenith, into the opposite south-eastern horizon, where they joined an expanded body of lurid carmine.

These appearances fluctuated till midnight, when the dark cloud in the north completely obscured the whole sea horizon, and its edges were fringed with radiant streamers.

At 12·30, or half an hour after midnight, a culmination of surpassing beauty occurred. Long streams of yellow, black carmine, light red, and emerald hues were projected towards the plane of the magnetic meridian, where they coalesced and formed a corona.

At 1 a.m., a blood-red radiance still existed in the N.E., and an arc almost due N. sent up faint parti-coloured radiating streamers to the zenith. Small detached rugged masses of what appeared to be pure cirrostratus, drifted over from W. to E.

Throughout the preceding day atmospheric electricity had been at times abnormally developed, and the dip of the magnetic needle was persistent for hours.

With regard to the origin of the varying tints of these beautiful phenomena, it should be borne in mind that the aurora is probably due to electrical discharges, between the positive electricity of the atmosphere and the negative electricity of the terrestrial globe. The electricities themselves are separated by the action of the sun on equatorial regions.

As in the case of lightning, the different hues of the aurora are produced (probably) by the varying altitudes. In the lower regions the light is white, but in the higher regions, where the air is more rarified, it takes a violet tint, as the spark of the electrical machine varies in an attenuated medium or a grosser atmosphere.

The winds are now cold and ungenial. Yesterday an icy stratum existed in the higher regions, as shown by the production of a solar halo.

Vegetation, nevertheless, steadily progresses, and has suffered little comparative injury, owing to the protracted drought. Scarcely a drop of rain has fallen since the 28th of March.

I am, Sir, your obedient servant,

Valley of the Clwyd: R. H. ALLNAT.
April 10.

From the *Standard*.

Sir,—The Northern Lights were distinctly visible here last night, at 10·30, the arc extending from W.N.W. to N.E., radiating from the N.N.W. I also observed through the luminous vapour, several stars shoot due north. Apologising for intruding on your valuable space,

I am, &c.,

St. Stephen's, Twickenham: April 10. E. B.

Sir,—A very beautiful Aurora Borealis was seen here last night. It appeared in the western heavens, the radius was of great extent, with much of that characteristic fine red hue in it. The whole display lasted from half-past ten till a few minutes after eleven, and was of a very fine description. I remain, &c.,

Leyton, Essex: April 10. OBSERVER.

Sir,—About twenty minutes past ten last night, I observed it was very light, and on looking out of doors I found there was a magnificent aurora display. The northern horizon was nearly as bright as day, and on watching it, it got dark, and rays of bright and red colour shot up to the zenith from N.E. to N.W., varying in brightness, the finest being about a quarter to eleven, when it gradually faded, till about ten minutes past, when I went in. Yours, &c.,

Round Oak, Greenham, Newbury: J. WARD.
April 10.

Edinburgh.—The temperature for some days past has been variable, genial mildness alternating with cold easterly winds. Sunday morning was cloudy, with east wind and a sprinkling of rain. In the afternoon the sun broke through, but the atmosphere continued cold. For two or three hours in the evening the northern sky was lighted up with a display of Aurora Borealis. The phenomenon began to manifest itself shortly after eight o'clock, in the shape of pale green and rose-tinted rays streaming up towards the zenith, from behind a bank of clouds in the north-east. After a time the rose tints disappeared, but the pale-green rays diffused themselves over the northern sky, converging from all points of the horizon to the zenith. When the phenomenon reached its fullest development, rather more than one half of the sky was covered with flickering streamers.—*Scotsman.*

Leeds.—A remarkably grand display of the Aurora Borealis was visible at Leeds on Sunday night. The extent of space over which the coruscations played was much greater than is usually the case, whilst the light was so vivid, and its tints were so quickly changed, as to produce a spectacle truly gorgeous. About twelve o'clock, apparently from a mass of black cloud resting just above the northern horizon, there shot forth innumerable streaks of light which reached to the zenith. The colour of these streaks was a pale green, with one exception—a broad band of light

of a dark purple hue lying towards the east. Whilst the lighter coruscations remained stationary for some time, or varied but little, the purple stream flickered, died away, then reappeared every moment, changing its position and its colour from dark purple to a brilliant red. Half an hour later the beauty and grandeur of the phenomenon attained their highest point. The appearance of the heavens at this moment may be best conceived by imagining a vast number of broad streaks of light, varied in colour with all the hues of the rainbow, converging at a point in the northern horizon, and spreading out, fan-like, to the zenith, and there covering an arc of a circle from 120 to 130 degrees in extent. This lasted but a few moments, when the scene again changed. Later still the north-western portion of the sky presented an appearance similar to that witnessed in the dawn of a bright summer's morning, when the sun first begins to fleck the eastern heavens. Shortly afterwards masses of black clouds overspread the sky, and prevented further observation.

Mr. T. H. Waller, of York, writes in *Nature*: "On first observing the green parts with a spectroscope of one bisulphide prism, the only line distinctly visible was the green one; but by watching and opening the slit there came into view two bands at the more refrangible end, more sharply defined at the more refrangible side than at the other; and there also seemed to be a considerable continuous spectrum from the green lines nearly to the least refrangible of the two bands. In the red parts the red line was most brilliant, quite equal in intensity to the green one, and then even in the green light it was distinguishable with care and long watching."

THE *Messenger of Mathematics.*—We notice that a new series of this publication will be commenced on the first of this month, and a number will appear once a month as nearly as possible, so that twelve sheets may be completed within the year. The subscription is to be 8*s.* 6*d.* per annum, paid in advance; single numbers, 1*s.* Papers are promised by Professor Cayley, Chief Justice Cockle, Mr. Routh, Mr. Esson, and others. It will be published by Messrs. Macmillan & Co., London; and by Messrs. Metcalf & Sons, Cambridge.

We have received Vol. V. of *Symon's Monthly Meteorological Magazine*, which contains much interesting and important information; also the "British Rainfall of 1870," by the same author. To show the pains taken with experiments on this subject, we may mention that at Hawsker, near Whitby, there are no less than twenty-seven various gauges. The observations have been made during the year at about 1,500 different stations in England and Ireland.

Nature learns that the volume containing the various observations of the recent total eclipse will be edited by the Astronomer Royal.

The Savilian Professor of Astronomy at Oxford (the Rev. C. Pritchard, M.A.), who went out with the Eclipse Expedition, will early this term give the scientific world the benefit of his researches in the form of a lecture on the recent solar eclipse.

The Vice-Chancellor of Cambridge has appointed J. Norman Lockyer, Esq., F.R.S., to the office of Sir Robert Rede's Lecturer for the ensuing year. Mr. Lockyer will deliver a lecture in the Easter term.

NOTICES OF OBSERVATIONS.—Allow me to make a suggestion which would I think, if carried out, much improve the value of the correspondence in the *Register*. It is a very simple one—that in *all* accounts of observations, the aperture and power used should be stated (*e.g.*, "6 in. O. G. 120," or "9 in. spec. 180"), and if on stars or planets, the proximity or absence of the Moon. This also would apply to the notes of the Observing Astronomical Society. That the proximity of the Moon affects the bringing out of details on the planets is well known, and I was much struck with it myself when observing Mars some years ago. ("Recreative Science," ii. 212.)

F. W. LEVANDER.

[We have before this asked our correspondents, in giving us accounts of their observations, to state in all cases the aperture, focal length, and power employed.—Ed.]

MARS.—The thanks of your readers are due to "M." for his tables of the position of the disk of Mars; but it would be desirable to know what is his standard in measuring the longitude. He seems to measure it from nearly the same meridian that R. A. Proctor uses, but goes round Mars the opposite way, his long. 30° being about the same as Proctor's 330°, and so on. An agreement should be come to as to which is the right way; to me, "M."'s seems the most natural.

Sunderland: April 13, 1871. T. W. B.

OBSERVATIONS FOR MAY, 1871.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich midnight	60°N.	0°	60°S.
	SUNRISE.		
	°	°	°
1871. May 1	−53·8	−55·9	−58·1
2	66·0	68·1	70·2
3	−78·2	−80·3	−82·4
	SUNSET.		
4	+85·5	+87·5	+89·7
5	73·4	75·4	77·4
6	61·2	63·2	65·1
7	49·1	51·0	52·9
8	36·9	38·8	40·7
9	24·8	26·6	28·5
10	12·6	14·4	16·2
11	+0·4	+2·2	+4·0
12	−11·8	−10·0	−8·3
13	24·0	22·2	20·5
14	36·1	34·5	32·8
15	48·3	46·7	45·1
16	60·5	58·9	57·3
17	−72·7	−71·2	−69·6

SUNRISE.

19	...	+85·8	...	+84·3	...	+82·8
20	...	73·5	...	72·1	...	70·6
21	...	61·3	...	59·8	...	58·4
22	...	49·0	...	47·6	...	46·2
23	...	36·7	...	35·4	...	34·0
24	...	24·4	...	23·1	...	21·8
25	...	+12·2	...	+10·9	...	+9·7
26	...	—0·1	...	—1·3	...	—2·5
27	...	12·4	...	13·5	...	14·7
28	...	24·6	...	25·7	...	26·8
29	...	36·8	...	37·9	...	39·0
30	...	49·1	...	50·1	...	51·1
31	...	—61·3	...	—62·3	...	—63·3

MARS.

Areographic longitude and latitude of apparent centre of disk, angle of position of axis, diameter, and amount and angle of position of greatest defect of illumination.

1871.		Longitude. 8h.	10h.	12h.	Lat. 12h.	Axis.	Diam.	Def. of Illum.	
May 1	...	346°	16°	45°	... 26·9°N....	22·9° ...	11·83″...	0·76″	115°
2	...	337	7	36	... 27·0	... 22·9 ...	11·74 ...	0·78	115
3	...	328	357	27	... 27·0	... 22·9 ...	11·65 ...	0·79	115
4	...	319	348	17	... 27·1	... 23·0 ...	11·56 ...	0·81	114
5	...	310	339	8	... 27·1	... 23·0 ...	11·47 ...	0·83	114
6	...	301	330	359	... 27·1	... 23·0 ...	11·38 ...	0·84	114
7	...	291	321	350	... 27·2	... 23·1 ...	11·29 ...	0·86	114
8	...	282	311	341	... 27·2	... 23·1 ...	11·20 ...	0·87	114
9	...	273	302	331	... 27·3	... 23·1 ...	11·11 ...	0·88	114
10	...	264	293	322	... 27·3	... 23·2 ...	11·03 ...	0·89	114
11	...	254	284	313	... 27·3	... 23·2 ...	10·94 ...	0·90	114
12	...	245	274	304	... 27·4N. ...	23·3 ...	10·86 ...	0·92	114

VARIABLE STARS.

Approximate time of minima and maxima of some variable stars, which, according to the statements made by Schoenfeld and Winnecke, may be expected in May.

1871		G. M. T. h.	m.			Place of star 1855. A. R. h.	m.	s.		Decl. °	′	
May 2	...			S Vulpeculæ	min.	19	42	27	+	26	55·7	
4	...	9	4	δ Libræ	„							
7	...			S Delphini	„	20	36	24	+	16	34·2	
9	...	9	4	S Cancri	„	8	35	39	+	19	33·2	
—	...			R Boötes	„	14	30	48	+	27	22·1	
11	...	8	8	δ Libræ	„							
18	...			R Camelopardali	max.	14	28	54	+	84	29·2	7m.
—	...	8	4	δ Libræ	min.							
19	...			R Capricorni	max.	20	3	10	—	14	41·6	9m.
28	...	8	7	S Cancri	min.	8	35	39	+	19	33·2	

NEW COMET.

A new comet was discovered on April 7, by M. Winnecke, at Karlsruhe.

Elements.

Epoch of Perihelion passage = 1871, June 11·23.

		°	′
Longitude of Perihelion	=	138	51
Longitude of ascending Node	=	278	19
Inclination of Orbit	=	88	5
Log. Perihelion Distance	=	9·8342	

Heliocentric Motion :—
Calculator :—Pechule.

Ephemeris.—For Berlin mean noon.

1871.		R. A.			Decl.		
May 1	...	4h. 4·1m.	...	+40°	20′		
2	...	4	7·4	39	40		40
3	...	4	10·6	39	0		40
4	...	4	13·8	38	19		41
5	...	4	17·0	37	37		42
6	...	4	20·1	36	55		
7	...	4	23·1	36	13		
8	...	4	26·1	35	30		
9	...	4	29·1	34	47		43
10	...	4	32·0	34	4		
11	...	4	34·8	33	20		
12	...	4	37·6	32	36		
13	...	4	40·4	31	51		45
14	...	4	43·1	31	6		45
15	...	4	45·8	30	21		45
16	...	4	48·5	...	29	35	
17	...	4	51·1	...	28	48	
18	...	4	53·7	...	28	2	
19	...	4	56·2	...	27	15	
20	...	4	58·7	...	26	27	
21	...	5	1·2	...	25	39	
22	...	5	3·6	...	24	51	
23	...	5	6·0	...	24	2	
24	...	5	8·4	...	23	13	
25	...	5	10·7	...	22	23	
26	...	5	13·0	...	21	33	
27	...	5	15·3	...	20	43	
28	...	5	17·6	...	19	52	
29	...	5	19·8	...	19	1	

The comet is slowly approaching the earth, and has an insignificant tail.

G. F. CHAMBERS.

Windyhills Observatory, Bickley:
April 21, 1871.

NOTICES TO CORRESPONDENTS.

Several communications are deferred from want of space.

Books Received. "Romance of Motion," by Alec Lee (will be noticed in our next). Report of Observing Astronomical Society (being a reprint of Papers which have appeared in the *Astronomical Register*).

Erratum in pp. 96 & 97. For *Clairvaut*, read *Clairaut*.

ASTRONONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1870.
Browning, J.
Clarke, J. S.

To March, 1871.
Metcalfe, Rev. R. W.

To June, 1871.
Cooke, T.
Cotsworth, H.
Elliott, R.
Hemming, Rev. B. F.
Jackson-Gwilt, Mrs.
Lancaster, J. L.
Lancaster, W. L.
Lawton, W.
Lee, A.
Lee, G.
Wright, W. H.
Woodman, T. C.

To Dec. 1871.
Abbot, F.
Bates, Rev. J. C.
Daw, F.
Horner, Rev. J.
Terry, J.

To Dec. 1872.
Longmaid, W. L.

April 28, 1871. Subscriptions after this date in our next.

THE PLANETS FOR MAY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	3 40 37	+22 7½	9″·6	1 4·5
	15th	3 28 16	18 7½	12″·0	23 51·2
		3 26 11	17 42½		
Venus ...	1st	4 52 59	+24 3	13″·0	2 16·7
	15th	6 5 37	25 25	14″·0	2 34·1
Mars ...	1st	11 22 54	+6 4½	14″·0	8 45·5
	15th	11 27 2	5 2	12″·6	7 54·6
Saturn ...	1st	18 42 13	−22 17½	15″·8	16 3·7
	15th	18 40 20	22 19½	16″·2	15 6·8
Uranus ...	1st	7 39 34	+22 0	4″·0	5 2·8
	13th	7 41 12	21 56½	4″·0	4 17·3

Mercury may be observed as a morning star during the latter part of the month, rising about half an hour before the sun. The planet passes the meridian twice on the 14th of this month, at 3·2min. past noon, and again at 23h. 57·2min., or about 3 minutes before noon, on the 15th.

Venus is situated as well as possible for observation this month.

Mars is visible throughout the night.

Jupiter is still visible for some time after sunset: about four hours at the beginning of the month, the interval decreasing to an hour and a half by the 31st.

Saturn is a morning star.

Uranus is fairly situated for observation.

ASTRONOMICAL OCCURRENCES FOR MAY, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon.
Mon	1		Sidereal Time at Mean Noon, 2h. 35m. 53·56	2nd. Sh. E.	9 10	— 9 26·5
Tues	2		Saturn's Ring: Major Axis=39″·56 Minor Axis=16″·83			10 16·8
Wed	3	13 27 14 25 14 7 14 51	Occult. of 94 Virginis (6) Reappearance of ditto Occult. of 95 Virginis (6) Reappearance of ditto	3rd. Oc. R. „ Ec. D.	8 37 9 26 56·4	11 8·9
Thur	4	10 59·9	○ Full Moon Meridian Passage of the Sun, 3m. 21·61s. before Mean Noon			12 3·6
Fri	5	17 4	Occultation of ν Scorpii (4)			Mars — 8 30·2
Sat	6			1st Tr. I. „ Sh. I.	9 2 9 54	8 26·4
Sun	7			1st Ec. R.	9 26 52·3	8 22·7
Mon	8	3 59	Conjunction of the Moon and Saturn, 1° 31′ N.	2nd. Sh. I. „ Tr. E.	9 2 10 7	8 19·1
Tues	9					8 15·5
Wed	10			3rd Oc. D.	10 8	8 11·9
Thur	11	2 23·2 23 0	☾ Moon's Last Quarter Conjunction of Jupiter and Venus, 1° 58′ N.			8 8·4
Fri	12					8 4·9
Sat	13					8 1·4
Sun	14			1st Oc. D.	8 23	7 58.0
Mon	15	1 0	Inferior Conjunction of Mercury Illuminated portion of disk of Venus=0·765 „ of Mars=0·913	1st. Tr. E. „ Sh. E. 2nd. Tr. I.	7 50 8 34 10 13	7 54·6

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Mars. —
Tues	16		Sidereal Time at Mean Noon, 3h. 35m. 1·89			7 51·3
Wed	17		Meridian Passage of the Sun, 3m. 52·22s. before Mean Noon	2nd Ec. R.	8 40 31·0	7 48·0
Thur	18	22 45·0 10 23	● New Moon Conjunction of Moon and Mercury, 1° 38′ N.			7 44·7
Fri	19	17 27	Conjunction of Jupiter and ι Geminorum, 0° 6′ S.			7 41·5
Sat	20					7 38·3
Sun	21	0 5 15 0	Conjunctionof Venus and ε Geminorum, 0° 3′ S. Conjunction of Moon and Jupiter, 0° 3′ N.	3rd Sh. E.	10 17	7 35·1
Mon	22	12 10	Conjunction of Moon and Venus, 1° 19′ N. Saturn's Ring: Major Axis=40″·62 Minor Axis=17″·38	1st Sh. I. „ Tr. E.	8 12 9 51	7 32·0
Tues	23	15 22	Conjunction of Moon and Uranus, 1°31′ S.			7 28.9
Wed	24					7 25·9
Thur	25					7 22·8
Fri	26			4th Tr. I.	9 3	Moon. — 5 41.4
Sat	27	1 2·3	☽ Moon's First Quarter			6 29·3
Sun	28	5 49	Conjunction of Moon and Mars, 4°39′ S.	3rd Tr. I.	9 9	7 16·9
Mon	29			1st Tr. I.	9 35	8 5·0
Tues	30	9 53 10 42	Occultation of 80 Virginis (6) Reappearance of ditto	1st Ec. R.	9 41 23·6	8 54·5
Wed	31					9 46·7

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MAY, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight. ° ′	Objects to be observed.
1	40 46	Anaximenes. Herschel II. (*a*). Sunrise on region N. of Herodotus. (*b*)
2	27 19	Aristarchus, character of its floor.
3	13 30	Segner, Rosse (*c*), Phocylides.
4	0 35	Maginus, full moon aspect of interior,
21	152 21	Hahn, Berosus, Condorcet (*d*).
22	141 29	Wrottesley (*e*), Snellius, Stevinus.
23	130 32	Taruntius, objects in interior.
24	119 25	Posidonius, and craters north of it (*f*).
25	108 5	Ridges on the Mare Serenitatis (*g*).
26	96 28	Cassini, Piazzi Smyth (*h*), Renuker (*i*).
27	84 28	Abenezra, Azophi, Agrippa Godin.
28	72 4	Short, Newton, Cabeus.
29	59 12	Sinus Iridum (*k*), Delisle, Diophantus.
30	45 52	Bianchini, Sharp, Mairan.
31	32 8	Campanus, Mercator, Capuanus.

For additional objects consult the lists for January and March. A comparison of the positions of the terminator, March and May, will be a good guide in selecting objects. On the 24th of March, the terminator had not arrived at Taruntius and Messier; these craters may be looked for on the 22nd.

(*a*) The finest of a fine group of formations near the N.E. limb, imperfectly represented by B. and M. See Reports of the British Association, 1862: Transaction of Sections, pp. 10—12; also *Monthly Notices R.A.S.*, vol. xxiv. p. 20.

(*b*) Well observed on March 3, 1871.

(*c*) See *Monthly Notices R.A.S.*, vol. xxiv. p. 20.

(*d*) There are two conspicuous craters, S. and S.S.W. of Condorcet, well seen on March 23. They are not in Webb.

(*e*) See *Monthly Notices R.A.S.*, vol. xxiv. p. 20.

(*f*) See *English Mechanic*, No. 308, Feb. 17, p. 516.

(*g*) With longitude of terminator at 60° N. latitude, varying from 20° to 12° W. and 24° to 12° in one equator, the ridges on the Mare Serenitatis may be studied to advantage.

(*h*) See *Monthly Notices R.A.S.*, vol. xxiv. p. 20. This crater with a mountain near it. named Piton, are situated between Plato and Archimedes.

(*i*) Named by the late Dr. Lee to commemorate the astronomical labours of the Director of the Observatory at Hamburg.

(*k*) On September 20, 1870, M. Gandibert discovered four ridges on the Sinus Iridum; they were seen with an aperture of 2¾ inches, on the 31st of January, 1871, when at least four additional ridges were detected with this small aperture.

Errata in former lists.

Jan. 24. For *Vandelinus*, read *Vendelinus.*
Feb. 27. For *Parrol*, read *Parrot.*
April 3. For *Sersalis*, read *Sirsalis.*
„ 22. For *Seminus*, read *Geminus.*
„ 24. For *Lithrow*, read *Littrow.*

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.
The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham Honse, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 102. JUNE. 1871.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Seventh Meeting, May 12th, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The President, on taking the chair, said that probably every one in the room was aware of the loss they had sustained by the death of their esteemed colleague, Sir John Herschel, which had struck all men of science like the loss of a personal friend, while to those who had the pleasure of knowing him intimately the deprivation could hardly be over-estimated. He (the chairman) would not now pretend to offer any eulogium of his departed friend—that would be done hereafter by abler men; but the eloquent writings, the great scientific knowledge, the kindness and urbanity of character, and other fine qualities of Sir John, were known to all. The Council had at once resolved to offer an expression of their warmest sympathy to Lady Herschel on her irreparable loss. He would read the resolution which he was charged to transmit to the widow; and if the meeting desired, he should be happy to add to it a statement that the whole Society concurred in the sentiments of the Council. Truly might it be said of their late Fellow, "We ne'er shall look upon his like again."

The address was as follows:—

"The Council of the Royal Astronomical Society have read with the deepest concern the announcement of the death of their eminent and much revered Fellow and former President, Sir John

Herschel; and although they feel reluctant to intrude on the privacy of Lady Herschel at this time of her poignant sorrow, they cannot refrain from expressing their heartfelt sympathy in her grief, and they beg permission to assure her how fully they have always appreciated the high attainments, the great genius, and the noble qualities, which characterised Sir John Herschel as a philosopher and as a man. In their opinion, no man in modern times has done so much to promote the advancement of science, in its most comprehensive sense, or to maintain for it an appreciation of its dignity."

The Fellows present at the meeting unanimously requested that their concurrence might be notified as suggested.

The Astronomer Royal said, that as probably the oldest friend of Sir John Herschel present, his intimacy extending over nearly fifty years, he was desirous of remarking that although the Council had in their address expressed all that was in their power, it would fall far short of what Sir John's friends would feel. For himself he could say, that of all men in the world he should have chosen Sir John as the representative of truth and kindness.

The minutes of the last meeting were read and confirmed.

Twenty-six presents were announced, and the thanks of the Society given to the respective donors.

J. H. Bluum, Esq.,
Clarence E. Trotter, Esq.,
Reginald Bushell, Esq., and
H. Mann, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

On η Argus and its surrounding Nebula: by Mr. Abbott.

On the Occultation of Uranus on March 2, 1871: by Mr. Maguire.

Capt. Noble having complained that he had been misled by trusting to the Nautical Almanac, as upon going to observe the occultation two minutes before the predicted time, he found the planet had already disappeared; the author recalculated the times of the phenomena, and found that the particulars given in the Nautical Almanac, which does not attend to fractions of a minute, were correct as to the disappearance, although there is an error in the prediction for reappearance. If Capt. Noble were at Maresfield, the calculated time was correct. Was there an error made in the moon's place or the planets?

Capt. Noble said there could be no mistake as to the fact that the planet disappeared before the time mentioned, as his clock was checked by a 2¾-inch Simms Transit, which gave him time to the tenth of a second.

Mr. Lancaster had also been disappointed by relying on the Nautical Almanac. He felt sure his time was not a quarter of a minute out.

The Astronomer Royal said, there appeared to be some little misapprehension between what the Nautical Almanac does on the one side, and what observers expect on the other. The Nautical Almanac gives the results attained by computations from the existing tables. The tables of the Moon are very correct, but the tables of Uranus are considerably in error. If the Greenwich observations be referred to, it will be seen that the results of observation and calculation show great discrepancies. There is a great want of fresh tables, but it requires much leisure and some talent in the computer, and perhaps some pecuniary aid.

The President inquired when the last occultation of Uranus took place?

The Astronomer Royal did not remember. Certainly not lately, but Uranus had been much observed on the meridian.

The President: If the last occultation is recorded, it should have warned observers in March to be five minutes early.

Capt. Noble: The conduct of the authorities seems to me comparable to that of a local board, who having to put up a direction-post at four cross roads employ a carpenter who cannot spell. I have repeatedly, in this room, called attention to the error of eleven minutes, or more, in the predictions as to Jupiter's Satellites, and yet they persist in printing tables from year to year, in our Nautical Ephemeris, which are admitted to be grossly wrong.

The President: I believe the calculations are made to be used with a telescope of 46-inches focal length; but with the larger telescopes now in use the phenomena are seen at different times.

Capt. Noble: Sufficient observations have accumulated for the correction of the tables, and if the Government will not pay for the computation of fresh ones, they ought at least to give warning their book is not to be relied on.

The President: Observers should certainly be prepared for possible errors.

Mr. Dunkin: The errors in the eclipses of the 1st and 2nd satellites are very small indeed; with the 3rd they are larger, and with the 4th very much so; but it should be remembered those of the 4th are very rare, and that very little improvement could be effected as to that satellite.

The Astronomer Royal corroborated Mr. Dunkin on this point, and having sent for a volume of Greenwich Observations, showed that in 1867 the errors of R. A. for Uranus were 15 or 16 seconds *of time;* while the error of N. P. D. was very small.

There was nothing comparable to this error in any other planet; even in the case of Neptune it was only one or two seconds. Tables could not be corrected by bits, but must be done throughout at once.

The President: Would this error in the tables account for the two minutes by which the occultation was lost?

The Astronomer Royal: Yes, far more. I see that the errors of Jupiter's fourth satellite are 5m. 11s., 3m. 43s., 3m. 11s., and so on; while those of the second satellite are only 19s. to 38s. The eclipses of the fourth satellite are cut off during a large portion of time, and are therefore rarely caught. If tables of satellites or planets are to be altered, it must be done at one operation, and completely, from beginning to end; and Jupiter's satellites are so mixed up together as to render this a most complicated matter, as account must be taken of them all at the same time, which makes it one of the most formidable practical operations in astronomy.

Mr. Dunkin: The occultation of Uranus took place six minutes before the time mentioned in the Nautical Almanac. There might as well be a warning note in future years.*

Note on the Reappearance of Encke's Comet in 1871: by Mr. Hind.

The places of this comet will be as favourable as possible for observation in the northern hemisphere at the coming apparition. No doubt very complete ephemerides will be issued from Berlin in good time, but a few early places may be useful, which have been calculated on the assumption that Forster's elements are correct.

Perihelion passage, December 29, 1871.

0h. G.M.T.			R. A.			Dec.	
			°	′		°	′
August	21	...	−31	11	...	+24	4
	31	...	31	48	...	26	0
Sept.	10	...	31	32	...	28	8
	20	...	29	57	...	30	32
	30	...	26	18	...	33	13
Oct.	10	...	19	19	...	+30	4

On the Total Solar Eclipse of 1878: by Mr. Hind.

The particulars necessary for observing at stations in the United States, at Denver, Colorado, and in the Havannah were given in this paper.

The Astronomer Royal mentioned that Mr. Hind had communicated to him the fact that the next total solar eclipse visible in the British Isles would be in the year 1999.

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* The Editor of the *Astronomical Register* must add his testimony to the necessity of this warning; three or four minutes before the given time he looked for the occultation of Uranus, but in vain.

On De Vico's Comet of short Period: by Mr. Hind.

This comet was discovered in 1844, but was not seen when expected again in 1850, nor was it detected in 1855, 1860, or 1866. An elaborate investigation by Prof. Brunnow seems to show there must have been some inaccuracy in observing the daily motion, and that for its rediscovery we must look to the labours of those astronomers who sweep for telescopic comets. The same observation applies to Peters' Comet.

Elements and Ephemeris of Comet I., 1871: by Mr. Hind.

These were calculated from the places given by Winnecke, the discoverer, on April 7, and two subsequent observations at Mr. Bishop's Observatory.

On the first Comet of 1867: by Mr. Hind.

This comet was discovered by Stephan at Marseilles, in January, 1867. Its period is 33·62 years. The author remarks on the near approach of its orbit to that of Uranus, and the singular commensurability between the bodies.

	Years.
5 × sidereal period of Comet =	168·120
2 × sidereal period of Uranus =	168·052

Affording a parallel to the well known 5 to 2 relation in the great inequality of Jupiter and Saturn.

If the elements used, which are those calculated by Mr. Searle, of Harvard College, be correct, the comet did not suffer any extraordinary perturbation in 1817, but in 1649 the distance may have been much less. The elements correspond well with the observations.

Ephemeris of the Periodical Comet of Tuttle for its approaching reappearance: by Mr. Hind.

The perihelion is calculated to occur on November 30, 1871.

The places from September 1 to October 19 range between—

R. A.						
$^\circ$	$'$	$''$		$^\circ$	$'$	$''$
100	13	2	and	+ 62	22	7
141	40			+ 37	20	8

The track is very favourable for observations.

Observations of Mars, with Drawings: by Mr. Joynson.

The paper was accompanied by a large number of drawings of the planet, made during the last opposition, as well as a repetition of some previously forwarded, made in 1862, 1864, and 1867. The first set were made with a refractor $3\frac{1}{2}$-inches aperture, the others with a 6-inch refractor. The drawings were made at intervals of 37 minutes, so that the face of the planet was completely changed in every 10 drawings, or about 6 hours. About one-fourth of the planet was seen at a time, or a whole hemisphere in 20 drawings. The north Polar snow was of less extent than at the

preceding opposition, and more like the southern snow in 1862. The general colour was yellowish or brownish, but near the poles this was difficult to observe, as the colour varied from night to night. The central band and wine-glass shaped channel are clearly permanent markings. The drawings are arranged with corresponding phases, one above the other, for easy comparison.

Capt. Noble thought the drawings very inconveniently arranged, and the north Polar snow much too small. He had made some coloured drawings of Mars, and wished to ask if any one had noticed during the last few nights that the gibbous shape of Mars made the Polar snow look quite pointed?

Mr. Browning had been drawing Mars, and thought the snow in Mr. Joynson's sketches about one-fifth of the proper size. He had distinctly seen the spot assume a sugar-loaf shape.

Une Nouvelle Spectroscopique: by P. Secchi.

Dr. Huggins translated this paper, which stated that the author had devised a new spectroscopic combination, by which the spots and solar prominences, with their spectral lines, could be seen in the same visual field. This was done in two ways. In the first, a large prism was placed in front of the object-glass, which caused a coloured image to fall on the slit of the ordinary spectroscope. The second plan was to place a prism of great dispersive power before the slit of the spectroscope. By both plans an image of the object in rays of one colour could be obtained, in which the spots and limb of te sun were very well defined, and the phenomena were seen as well as with coloured glasses, and the chromosphere and protuberances exhibit themselves as bright lines extending more or less from the limb. This mode gives the prominences only as lines, as in Jansen's method, but it is possible to map them by the height of these lines. If the slit be opened more, the shape is seen, but the definition lost. When closed sufficiently the spots and prominences are seen by the lines. If we get the line C brilliant or less black, it shows hydrogen. Calcium and iron are also seen by their lines.

Mr. Browning said it was desirable to explain what had been done, as otherwise the paper might not be understood. Dr. Huggins had been experimenting in the same direction. The plan was to take a direct vision prism of great dispersive power. If we looked through this at a tree or a house, we got an image of it of one colour. The proposition is to magnify this image by a telescope. With the sun's image thus obtained, the lines C and F of hydrogen would be seen; and the lines of the whole of the sun's limb, and prominences in succession.

Dr. Huggins: Father Secchi seems to use a direct vision prism before the slit, or before the object glass, to get light of one

colour, and get rid of all false light. The plan I thought of is somewhat different. It was to place the slit some distance within the cone of rays from the object-glass, before they reached the focus. The image of the sun was then formed behind the lens of the collimator, and among the prisms. If an eye-piece be used with the small telescope, an image of the slit is seen, and the ordinary solar spectrum. Then I brought the C line to the centre of the field, and removed the eye-piece of the telescope. A slit being placed there, and the eye to the narrow opening of the slit, light of the refrangibility of C, and no other, could enter the eye. As the solar image was formed about as far in the front of the object-glass of the little telescope as the eye behind it, the sun was seen, not a spectrum, of that particular refrangibility, and I hoped to see the prominences surrounding it. Though I saw the limb distinctly defined, I failed to see the prominences on account of the diffraction bands produced by the edges of the slit, which produces a series of images that enfeeble the light too much. It might probably work with a more powerful spectroscope and a wider slit. It is essentially different in principle from Secchi's plan; and by this method any object can be seen with monochromatic light.

Note on the Change in Colour of the Equatorial Belt of Jupiter: by Mr. Browning.

The last number of the *Astronomical Register* contains a report of a discussion on this subject, at the monthly meeting of the R. A. Society, in which, with the exception of Messrs. Ranyard and Penrose, the whole of the speakers considered that no change had taken place in the colour of the planet.

It was suggested that the reason the colour on the equatorial belt is seen by many observers, while it was not seen in previous years, is to be accounted for by the fact that within the last few years many observers have become possessed of silvered glass reflectors of large aperture.

With all deference to such admirable observers, I would beg to point out that such an explanation will not hold good in my own case.

Five years ago I began making careful coloured drawings of Jupiter with a reflector of 10¼-inches aperture. Several years ago I drew attention to the fact that colour is best seen with small apertures, unless high powers be used. I worked with powers from 350 to 500 whenever the air would permit me. Although at that time I saw easily the coppery grey of the dark belts, and the bluish grey of the poles, I could detect no colour on the equatorial belt. Yet for the last two years the tawny colour of the equatorial belt has been more conspicuous than either.

It is true that during the last three years I have had a 12¼-inch equatorial reflector, but practically I have seldom indeed used more than 10 inches of aperture.

Several observers have seen the tawny colour of the belt with both refractors and reflectors of only three or four inches aperture.

The exact colour of the equatorial belt may be obtained by allowing a very powerful light to pass through a jet of steam, so that an increase in the luminosity of the body of the planet would completely account for the colour of the belt.

If, as I suspect, the colour appears periodically, we shall have to wait four or five years before we can decide this matter. Colour observations are, I am aware, liable to many sources of error; but I cannot think that any person accustomed to the use of colours could mistake yellow ochre for white, under the peculiar circumstances of this case, for during the whole of the time the change in colour has been going on upon the equatorial belts, belts to the N. and S. of it have remained almost colourless.

On the Use of Compound Prisms: by Mr. Browning.

On a Double Automatic Spectroscope: by Mr. Proctor.

The author states that Mr. Browning having constructed the double battery of prisms in an automatic spectroscope, which he (Mr. P.) had suggested last September, he now proposed a modification, in which simple prisms were to be replaced by Grubb's compound prisms, and sent a diagram of the contrivance. He admitted that this form would present considerable difficulties for the optician and mechanician to surmount, but after what had been accomplished, expected it would soon be done.

Note on η Argus: by Mr. Tebbutt, jun.

This paper was a series of comparisons of the star with others, from 1854 to 1870, during which it had dwindled down in magnitude from 1·10 to 6·25, having for the last three years been invisible to the naked eye. From 1854 to 1863, the author used stars, contained in certain tables in Sir J. Herschel's Cape Observations, and subsequently stars carefully selected and compared by himself. The observations were combined into groups, and the result projected in a curve, which showed a small annual fluctuation in the light of η Argus, above and below the mean magnitude, amounting to about a quarter of a magnitude, and evident during the last three or four years.

Mr. Ranyard read some extracts from the Philosophical Transactions, to show that the change of colour in Jupiter's equatorial belt had been noticed by Sir W. Herschel. Thus in 1790 he described the equatorial zone as of a yellowish cast; but in 1792 as of a brownish grey. He had, therefore, evidently noted

a change of colour. In connection with the sun spot curve, it was an interesting fact that the colour was reddish at the maximum and yellow at the minimum. By comparing the twenty-six spots referred to at the last meeting with the sun spot curve, it would be seen the white spots coincided with the maximum, and the black with the minimum.

On a free regulator Clock: by Mr. Kincaid.

Dr. Huggins said that it might be interesting to the meeting to hear some account of his recent observations of the *Spectrum of Uranus*. Having made a drawing of the spectrum, and some of the principal solar lines, he proceeded to state that the planet's spectrum was distinguished by six strong bands due to absorption at the planet. The Fraunhofer lines could not be seen, as when he attempted to close the slit of the instrument sufficiently for this purpose the light was too weak; but with a wide slit six planetary lines were visible. Measures of these had been obtained, from which it appeared that one was coincident with F, one near E, one on each side of D, and one halfway from C to D. None of these were in the position of the earth's atmospheric lines. He tried a direct comparison of hydrogen with the F line, with which it seemed to coincide. Three of the lines were very near the three principal lines of nitrogen, but when nitrogen was compared with the strongest, the latter was a little more refrangible. The other two were very near indeed to nitrogen lines, but not quite coincident, so that they could not be attributed to that gas. Two others were not far from the carbonic acid lines, and were compared with it, but were not coincident. At present, therefore, it must be admitted we do not know the cause of these lines. In 1869, Secchi observed the Spectrum of Uranus, but his account differed materially from the present appearance. He stated that a considerable part of the spectrum was cut out, and that there were two bands, probably some of those seen by the speaker, while the others seen nearly together might look like a gap in the spectrum. Dr. Huggins further stated that the comet now visible had been observed by him, and proved to exhibit the same three bright bands he had observed in the comet of 1868. One was a little more refrangible than *b*. He had measured these bands, and had no doubt they were the same as seen in 1868.

The meeting then adjourned.

The *London Gazette* of the 19th ult. announces that the Order of **the Bath has been conferred upon G. B. Airy, the Astronomer Royal; and Admiral Richards, Hydrographer of the Admiralty.**

THE LATE SIR JOHN HERSCHEL.

(From the *Times* and other sources.)

We have to record the death of Sir John Frederick William Herschel, F.R.S , &c., the only son of Sir William Herschel, who just 90 years since discovered Uranus, first called Georgium Sidus, and sometimes also Herschel, whose initial H stands for its symbol. His mother was Mary, daughter of Mr. Adee Baldwin ; he was born at Slough, Buckinghamshire, on the 7th of March, 1792. He was educated privately, under a Scotch mathematician named Rogers, from whose hands he passed to St. John's College, Cambridge, where he took his Bachelor's Degree in 1813, coming out as Senior Wrangler and first Smith's Prizeman. In the same year he published his first work, *A Collection of Examples of the Application of the Calculus to Finite Differences.* In 1819 he commenced a series of papers in the *Edinburgh Philosophical Journal* on miscellaneous subjects in physical science, and in 1822 communicated to the Royal Society of Edinburgh a paper on the absorption of light by coloured media, which will be found in the *Transactions* of that society. He spent a great part of the years 1821-23, in conjunction with the late Sir James South, in making a number of observations on the distances and positions of numerous stars, a full account of which is to be found in Part III. of the *Philosophical Transactions* for 1824, in which year they reported to the Royal Society the position and apparent distances of 380 double and triple stars obtained by more than 10,000 measurements.

In the summer of 1825, he made a series of observations to determine the dfference of the meridian of the Royal Observatories of Greenwich and Paris, and began to re-examine the numerous nebulæ and clusters of stars which had been discovered by his father. On this work he was employed for eight years, and its results will be found in the above-mentioned work for 1832. The catalogue includes upwards of 2,300 nebulæ, of which 525 were discovered by Sir John himself. It may be added that while engaged upon this work, he also discovered between three and four thousand double stars, which are described in the *Memoirs of the Astronomical Society.* These observations were made with an excellent Newtonian telescope, 20 feet in focal length and 18½ inches aperture ; and "having obtained," to use his own words, "a sufficient mastery over the instrument," he conceived the idea of employing it in the southern heavens. To this end, at his own expense, he set up an observatory in 1834, at Table Bay, and continued his observations there till May, 1838. In 1847 he published the results in a volume, entitled *Results of Astronomical Observations made during* 1834-38 *at the Cape of Good Hope; being the Completion of a Telescopic Survey of the Whole Surface of the Visible Heavens, commenced in* 1825, the expense being borne by the Duke of Northumberland.

The main object of his survey of the southern hemisphere was to discover whether the distribution of the stars in the southern hemisphere corresponded with the results of his father's labours, which were prosecuted chiefly on the Galactic circle. The whole number of stars counted in the telescope amounted to 68,948, which were included in 2,299 fields of view. By a computation based on the star gauges in both hemispheres relative to the Milky Way, Sir John found the stars visible in a reflecting telescope, 18 inches aperture, amounted to 5,331,572, and more than this, for that in some parts of the Milky Way the stars were so crowded as to defy all attempts to count them.

Besides his astronomical labours at the Cape, he was always ready to give the colonial authorities his advice and aid on scientific and educa-

tional matters. It is to him that the Cape colonists are mainly indebted for the very perfect system of national education and public schools which they now enjoy, and which he was enabled to carry out through the sagacity and liberality of the late Sir George Napier, at that time Governor, and of his Colonial Secretary, Mr. Henry Montagu.

Sir John Herschel's residence at the Cape was productive of benefits not only to astronomy but also to meteorology. While occupied there, he suggested a plan of having meteorological observations made simultaneously at different places—a plan subsequently developed at greater length in his *Instructions for Making and Registering Meteorological Observations at various Stations in South Africa*, published under official military authority in 1844. He had already received from the hands of King William IV. the Hanoverian Guelphic Order of Knighthood, and on his return to England, in 1838, he was received with every possible public honour. During his absence in the southern hemisphere, the Astronomical Society had voted to him their Gold Medal in 1836. Two years later, on the coronation of Queen Victoria, he was created a baronet. In 1839 he was made an honorary D.C.L. of Oxford University, and there was a proposal, which he declined, to elect him to succeed the late Duke of Sussex in the presidential chair of the Royal Society. In 1842 he was elected Lord Rector of Marischal College, Aberdeen. In 1848 he was President of the Royal Astronomical Society, and in the same year the society voted him a testimonial for his work on the southern hemisphere.

In addition to various incidental papers published in the *Transactions* of the Astronomical Society, he gave to the world the *Outlines of Astronomy* (enlarged from the former treatise in *Lardner's Cyclopædia*), which he published in 1849. In the same year he edited a collection of papers by various authors, published by authority, and entitled, *A Manual of Scientific Inquiry, prepared for the Use of Her Majesty's Navy, and adapted for the Use of Travellers in general.* In December, 1850, when the Mastership of the Mint was converted from a ministerial into a permanent office, it was conferred upon Sir John Herschel, and this post was retained by him till 1855, when he resigned it on occount of ill-health, and Professor Graham, the eminent chemist, was appointed his successor.

Sir John Herschel was the author of the articles on "Isoperimetrical Problems" and "Mathematics," in the *Edinburgh Encyclopædia*, and of "Meteorology" and "Physical Geography" in the *Encyclopædia Britannica* (the last two of which have been republished separately), and also of several articles on scientific subjects in the *Edinburgh* and *Quarterly Reviews*, which were collected and published in a separate form in 1857, together with some of his lectures and addresses delivered on public occasions. He besides occasionally contributed to *Good Words* some popular papers on the wonders of the Universe; and some two or three years ago he gave to the world, in the pages of the *Cornhill Magazine*, a poetical version of part of the *Inferno* of Dante. He was also one of the too numerous translators of *Homer*.

From the Catalogue of the Royal Society we learn that he contributed 180 memoirs to the *Scientific Transactions*, and journals devoted to science; two others, in conjunction with Mr. Babbage and the one with Sir James South : he contributed also treatises on "Sound" and "Light," to the *Encyclopædia Metropolitana*.

Sir John Herschel was an honorary or corresponding member of the academies of St. Petersburg, Vienna, Gottingen, Turin, Bologna, Brussels, Naples, Copenhagen, Stockholm, and of almost all other scientific associations in England and America. To his other honours were added that

of Chevalier of the Prussian Order of Merit, founded by Frederick the Great and given at the recommendation of the Academy of Sciences at Berlin. Few philosophers of an age which has produced a Faraday and Brewster have attained distinction equal to that which he earned for himself. His mathematical acquirements and his discoveries in astronomy, in optics, in chemistry, and in photography were all of a very high order, and such as, aided by an admirable style, secured for him the widest reputation among men of scionce, both at home and abroad; while his numerous popular writings have largely contributed to the diffusion of a taste for science, and an acquaintance with its principles among our countrymen.

Sir John Herschel married in 1829 Margaret Brodie, daughter of the Rev. Dr. Alexander Stewart, by whom he had a family of nine daughters and three sons. One of the former is married to General the Hon. Alexander Gordon, uncle of the present Lord Aberdeen, and now heir presumptive to that title. His youngest son is an officer in the Royal Bengal Engineers. He is succeeded in the title by his son, Mr. William James Herschel, of the Bengal Civil Service, who was born in 1833, and married in 1864 Miss Anne Emma Haldano Hardcastle, daughter of the late Mr. Alfred Hardcastle, of Hatcham, Surrey.

FUNERAL OF SIR JOHN HERSCHEL.

The funeral of Sir John Herschel took place on Friday, the 19th of May, at Westminster Abbey, in the presence of a large circle of attached friends, nearly all the men of science of the day, and a numerous assemblage of the public, who filled the sides and west end of the nave. At 12 o'clock the body, which had arrived by railway from Kent half an hour before at the Charing Cross Station, in a hearse attended by a single mourning coach, was carried into the nave by the cloister entrance, as the choir, accompanied by the organ, sang the well-known sentences beginning "I know that my Redeemer liveth." The procession having wound its way up the nave and reached the sacrarium, the coffin, which was of plain polished oak, with a plate bearing the following inscription:

"Sir John F. W. Herschel, Baronet,
Born 7th March, 1792;
Deceased 11th May, 1871."

was placed on trestles before the altar. The lesson was read by Archdeacon Jennings. The remaining portion of the service was sung at the grave by the choir, except the part read by the Dean, and it concluded with the anthem of Handel, "His body is buried in peace; but his name liveth for evermore." The Dean gave the final blessing. The Canons present on the occasion were Canon Nepean, Canon Jennings, and Canon Protheroe, and the whole body of minor canons attended. The grave is at the eastern end of the north aisle, near to the tomb of Sir Isaac Newton, under the painted window recently erected to Robert Stephenson, and at the foot of the monument to Lord Livingston. The pall-bearers were—the Duke of Devonshire, Chancellor of the University of Cambridge; M. le Duc de Broglie, Member of the Institute of France; Mr. George B. Airy, the Astronomer Royal; General Sir Edward Sabine, President of the Royal Society; Sir Charles Lyell; Mr. William Lassell, President of the Royal Astronomical Society; Sir Henry Holland, President of the Royal Institution; and Sir John Lubbock. The list of mourners included

Mr. A. S. Herschel, chief mourner, General the Hon. A. Gordon, Mr. Reginald Marshall, Mr. John Stewart, Messrs. Edward and Henry Hardcastle, Mr. William Spottiswoode, Dr. Parry, Bishop Suffragan of Dover; Mr. H. C. Morland, Mr. J. P. Gassiot, Colonel Strange, Mr. G. R. Waterhouse, the Rev. Charles Pritchard, Savilian Professor of Astronomy; Mr. J. H. Nelson, Mr. A. J. Beresford-Hope, M.P., Professor Tyndall, Professor Owen, Professor Adams, the Rev. J. Jeffreys, and Sir Charles Wheatstone. Among those also present in the Abbey were Sir John Bowring, Mr. Charles Darwin, the Dean of Salisbury, Messrs. Norman Lockyer, M. D. Conway, and Warren De la Rue, Professor Sylvester, Lady Augusta Stanley, and several other ladies, and a large number of men celebrated in every department of science.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE COLOUR OF JUPITER'S BELTS.

Sir,—It does not seem quite clear what was the real point of issue in the discussion on this subject, reported on pp. 107-9 of the *Register*, but the colour of the equatorial zone has latterly been dwelt upon so fully, that readers of the report only will naturally conclude that the fact of extensive change in that part of the planet is disputed by most of the eminent observers who took part in the discussion. Considerable weight was attached to the argument of the uncertainty of judgment as to colour, when observations are made at different times, and especially with instruments of diverse powers. May I be excused, in view of this, for the following remarks?

I made a good many observations of the planet with my 9-inch "With-Browning" reflector, during the apparition of 1868, and always saw the equatorial zone white, without any more trace of colour than faint marbling, apparently the darker body appearing through the thinner edges of masses of clouds, and once a faint streak. My latest note on this point in 1868 was made Dec. 23. I have mentioned on p. 173 of the last volume, that I first saw this zone yellow, August 28, 1869, while another zone N. was *very* white. I am not aware of any published observations before Mr. Browning's paper to the R. A. S., November 12. Acknowledging difficulties where colour is concerned, is there any possible explanation of observers independently seeing these zones with strongly contrasted tints, and using terms of similar import, excepting the objective character of the colours themselves? These may be what they were in 1862, but assuredly not as in 1868.

It is commonly stated that the principal belts are ruddy, but they are by no means invariably so; the proof of this is in character with that of the yellow zone above mentioned.

Some of the simultaneous appearances may be placed together:

N. tropical.	S. tropical.
	[Double both.]
Brownish, fading into yellow on the lower side.	Bluish grey.
Yellowish brown.	Lower streak, brownish. Upper, bluish grey.
Bluish.	Brown.

The N. temperate belt has been seen bluish grey.

Let us hope careful notes will continue to be made, and some day interesting results will appear. I am, yours truly,

London: May 13, 1871. T. H. BUFFHAM.

LUMINOUS BODIES SEEN BY DAY.

As interest has sometimes been excited by accounts of meteoric bodies (? seeds) being seen in the telescope by day, I may mention that about 2 p.m. yesterday, while trying to pick up Mercury, a bright object sailed across the field of my telescope. At the moment I imagined it was Mercury, and that the instrument had not been clamped, and had thus swung passed the object. But another and another went by, and there was evidently more than one Richmond in the field. Their direction was from the north-east apparently, indicating of course south-west. The weather-cocks when consulted pronounced the breeze north-east, but some smoke was noticed blowing from the westward, while some grass thrown up went in no fixed direction. As the telescope, however, was focussed for a planet, anything seen at all distinctly in it must have been at a considerable elevation. More than a dozen of these luminous objects passed, slightly varying their direction, and one, it was thought, described a somewhat curved path. My own impression was that they were floating seeds illumined by the sun, then shining brilliantly, and the season is favourable to this interpretation. A power of 30 was used on a $3\frac{3}{4}$-inch refractor.

Ventnor: May 9, 1871. G. GUYON.

SKETCHING WITH THE TELESCOPE.

Trifling hints in matters of contrivance are sometimes useful. In sketching planetary features on the observatory slate, white markings are made upon a dark ground, the reverse of the objects pourtrayed. I find a child's *transparent slate*, which costs from 4*d*. to 1*s*., a useful article for this purpose. Mine is about nine inches by seven, and in place of the usual pictures, a piece of cardboard is fitted, on one end of which are pasted a blank diagram of Mars and another of Jupiter, side by side. These showing through the ground glass, allow drawings to be made. After this the cardboard may be turned upside down, which brings the diagrams under clean portions of the ground glass, ready to receive fresh

sketches. Black paper covers the reverse side of the cardboard, on which is pasted a circular piece of white paper, the size which the sun appears with my lowest power giving a whole-disc view; with this the solar spots can be sketched in their respective positions. Of course, as with the ordinary slate, the sketches are intended to be afterwards copied. The glass should be finely ground, and a soft lead pencil used lightly.

Ventnor, Isle of Wight: G. GUYON.
May 9, 1871.

AURORA BOREALIS OBSERVED AT FLORENCE ON THE EVENING OF THE 18th APRIL.

By G. B. Donati.

Last night whilst making preparations for observing a small comet now visible in the constellation of Perseus, we were all at once surprised by the appearance of an uncommon reddish light in the N.W. It was a very fine aurora, which extended on the horizon 40 degrees from the breast of Perseus as far as the crown of Cepheus. It was formed of a great arc of blood colour light, terminated at the extremities by two rays longer and more brilliant than the arc. The ray or streak on the west was the higher and the more luminous; it passed a little beyond α Persei, that is to say, it was about 30 degrees in altitude. The other ray in the north, which was fainter, was about 25 degrees in altitude. This was precisely at 9 o'clock At 9h. 20m. the two rays altered their position about 10 degrees towards the north, and their light began to vary at intervals; the western ray diminished, and the northern became more luminous. Five minutes afterwards, the light underwent a great and almost instantaneous dimunition. At 9h. 24m. a very luminous bolide traversed the constellation of Boötes. At 9h. 30m. the aurora had entirely disappeared, but where it had appeared there was seen a diffused and whitish light, which lasted till after 11 o'clock.

Although this aurora was very inferior to the very beautiful one which was seen in Florence and throughout all Italy on the 24th October, last year, yet it must be ranked amongst those of rare beauty in our climates. That which surprised me in the aurora of the 24th October, was the sudden cessation of a very strong wind as soon as the aurora appeared. Yesterday, likewise, a strong south-east wind which was blowing, immediately ceased at the moment of the aurora. We have learned this morning by telegraph that the aurora was observed also at Urbino, and at S. Giovanni in Persiceto. . . . . Extraordinary magnetic perturbations were remarked yesterday in various places. One needle marked last night, at 9 o'clock, a declination much greater than usual, and from 9h. to 11h. the declination diminished by degrees 25 minutes of arc, in an unusual manner.

Donati makes some concluding reflections on the certain but still mysterious link which unites the three phenomena of the solar spots, terrestrial magnetism, and polar auroras.

Florence: 19th April, 1871.

RECENT PUBLICATIONS.

The Great Pyramid of Jizeh; the Plan and Object of its Construction. Cincinnati: Robert Clarke, 1871.

This pamphlet is simply a repetition of the arguments brought forward by Professor Piazzi Smyth and others, in defence of the Pyramid being a divinely inspired work as a standard of measure. It also enters into the very doubtful question of the Anglo-Saxons being the lost tribes of Israel. "Ho, ho! come forth and flee from the land of the North" (*i.e.*, north quarter of Europe). "Israel and Judah shall be brought together and made one nation."

"Were the blind eyes opened," says the writer, "it is quite possible that even in this *New World* of ours, one would suddenly come to the realisation that he was dwelling in the midst of the teeming multitudes of Israel terminating their emigration in a land long promised, long reserved; under the government of a commonwealth restored; free from every taint of *caste*, condition, or kingly rule." It is but fair to say that he prefaces his tract with the observation that any discovered solution of such subjects must be received with very much reserve.

We are glad to see the new volume of *Results of Astronomical Observations made in the Melbourne Observatory, in the Years* 1866, 1867, and 1868; under the direction of R. L. J. Ellery, the Government Astronomer. Published by Authority of the Government.

The astronomical work with which the Melbourne Observatory was occupied during these years, consisted almost entirely of observations for the determinations of the fixed stars, made with the transit circle and with the east transit instrument. The observations with the latter instrument, however, form part of the Survey of the Southern Heavens, now being prosecuted by the Cape of Good Hope, Madras, and Melbourne Observatories. The results of the Transit Circle Observations only are given in the present volume.

The Meteoric Theory of Saturn's Ring. By Augustus Morse Davies, B.A., F.R.A.S., M.R.I., P.A.C., Lieut. Royal Artillery. Longmans, 1871.

Mr. Davies in this volume has brought together and further reasoned out the arguments in favour of the ring of Saturn being an appendage due to the planet having encountered and attached to itself myriads of meteoric satellites during its wanderings through space. The book concludes with a discussion of the meteoric origin of the Sun's heat and power.

Mr. Davies disbelieves in the true existence of the solar corona as a real solar appendage. The book is profusely illustrated with diagrams.

The Romance of Motion. By Alec Lee. London: Longmans, Green and Co.

The object of this pamphlet is best shown by the following extract from the preface. "The opening remarks on the paper on motion are designed to show that the position presently held by astronomy with regard to the motions and velocities of the planetary bodies is not unassailable, and the other portions are devoted to the consideration of their peculiarities on the hypothesis that the ether in space is a material substance, and that the various world systems are upheld by the continued operation of a duality

of forces, and not, as heretofore alleged, by one well directed primal impulse, acting in combination with one continuous force of gravitation."

So with the analyses and syntheses of nitrogen.

"If the subject were reasoned out a little further than appears in the context, the oceans of the air and the water might be found to be the two great reservoirs of the organic matter of our planet, &c. Should the principle of this analysis prove correct, we may come to a consciousness of the possibility of such further reduction of our simple bodies as must ultimately point to a common origin for all things."

Most modern physicists believe the ether to be a real substance, and if it is so, doubtless it must act upon the motions of the heavenly bodies. This little tract tentatively and hypothetically treats of this influence, and more especially of the possible influence of magnetic and diamagnetic forces upon the planetary bodies. The subject of motion, as well as of simplification of elements, is full of interest, but it will be many years, probably, before any amount of reasonable certainty is arrived at with respect to them.

NOTES FROM THE SOUTHERN HEMISPHERE.

Sir,—Mr. H. C. Russell, the Government Astronomer for New South Wales, has just published a very interesting and important pamphlet on the wonderful mysterious nebula surrounding η Argus.

On comparing Mr. Russell's map with Sir J. Herschel's, in his Cape Observations, a most unmistakable proof of change in the form of the nebula is at once seen.

Thinking the publication in question might be of use to the *Register*, and prove interesting to its readers, I enclose a copy.

On the night of the 23rd and 24th March, a most remarkable aurora was seen in Sydney from about 9.30 p.m. to 2 a.m. (Greenwich mean civil time, March 23rd, 11·30 a.m. to 4 p.m.). I send a cutting from a Sydney paper, with Mr Russell's Report. It would be interesting to learn whether any disturbance was noticeable in Europe at the same time.

I remain, yours truly,

Sydney, 25th March, 1871. W. J. MACDONNELL.

[We wish it was in our power to give our readers, as an illustration, the beautiful map accompanying this tract, without which we fear we could not convey any valuable information upon the subject. The observations were made with an equatorial 7½-inch aperture and 10-foot 4-inch focal length. The writer believes that changes have taken place in this great nebula since Sir John Herschel was at the Cape, and that there is a probability that the changes will still go on. We add the account of the aurora sent by our correspondent.—*Ed.*]

BRILLIANT AURORA AUSTRALIS.—For a considerable time before and after midnight on Thursday there was visible in Sydney an aurora of most brilliant hue. Stretching in a regular arch of large diameter, from the horizon at the south-east to the south-west, from the point of the Milky Way under the constellation Scorpio almost to Sirius, covering the Magellan Clouds and reaching up to the star Canopus, was a broad belt

of red cloud-like light, and darting up from the horizon streaks of white flashed across the face of the clouds. At one time a cluster of these white streaks, formed in the centre of the arch, where the belt of red cloud was the widest, gave it the appearance of an immense organ. Every moment the form and hue of the aurora changed. Sometimes there was not a streak to be seen—nothing but the diffused red cloud, like the reflection from an immense fire; then in a second straight lines of light would dart from the south. The whole pageant faded and almost vanished, and again as suddenly burst forth with lurid glare. The most brilliant appearance observed was from ten to fifteen minutes past twelve. At half-past twelve there was scarcely a trace left of the magnificent illumination. After the above was written we were favoured by H. C. Russell, Esq , Government Astronomer, with the following remarks on this beautiful phenomenon:—"Brilliant aurora began at 9.35 p.m. in S.S.W., rose pink, and about 15° high; at 9.38 one bright white streamer shot up to 20°, in S.S W., followed by another due S., at 9.39, then one between them, and then several smaller ones near the large ones; streamers lasted about three minutes, then faded; the auroral light extended from S.W. to S.E., and when highest rose to 20°, and was deep red. At 9.50 it had nearly faded, but increased again at 10 p.m.; at 10.3 p.m. faded again; at 10.4 p.m. white light was observed under the red, and immediately afterwards another ray started up to 20°, rather wider than the previous ones, and red in colour. About midnight it again became bright, and auroral light was visible to S. all night. This is the finest aurora seen here since 24th September last, and seems to have been visible over the colony, as it was well seen at Eden and Newcastle."

THE TRANSIT INSTRUMENT AT DUBLIN OBSERVATORY was erected in 1808, it having been ordered in 1783. This delay was in one respect fortunate. Ramsden having quarrelled with Usher, resolved that the latter should never have the circle. On Usher's death, Ramsden set to work to complete it but found to his dismay, that the extremities of its radial arms had become "rotten," having been acted on by the sulphurous atmosphere of London. As originally constructed, it was ten feet diameter. He removed the rims (which, I believe, had been also acted on), cut away about six inches from each of the arms, and found the remainder sound. But as he was doubtful about its permanence he let it lie several years longer, and found his apprehensions verified. He cut off six inches more from each arm, and awaited the result, notwithstanding the urgent expostulations of Brinkley; and it was not until a short period before his death that he was satisfied that no farther change was probable. He then completed it at its reduced diameter of eight feet. But it was not divided till after his death (by Berge, his successor). It is not easy to explain why this destruction was confined to the ends of the arms. To judge from the analogy of the Palermo circle, the diameter of these arms at the outer extremity was very small; and if they were of cast brass, the molecular condition of the metal there, in consequence of the more rapid cooling, may have been different from that of the more massive portions. A still more remarkable instance of this destructive action occurred to a circle described by Mr. Bond in the *Philosophical*

Transactions, 1806, and known as the Westbury circle. This was ultimately established at the old Observatory of the Glasgow University, and in an atmosphere still more sulphurous than that of London. When this University was broken up, and its instruments sold, this circle was purchased by the late Sir James South; but on its arrival at his Observatory, it was found to have suffered so much that it actually fell to pieces! Only a few of the more massive parts were entire; and of the rims of the circle nothing remained except that which carried the divisions, which, as I was informed by Troughton, was of "Dutch brass," and was quite unchanged. The excellence of this Dutch brass is, I believe, recognised also by watchmakers, and it seems to deserve inquiry to what its superiority over English brass is to be attributed. It is worthy to be mentioned that among the instruments ordered from Ramsden by Usher, was an equatorial telescope driven by clockwork. But owing to Ramsden's feud with Usher, this was not executed; and this important aid to the astronomer, which had been proposed by Hook nearly a century before, lay dormant till it was applied by Frauenhofer, forty years later, to the Dorpat telescope.—Armagh: April 6. T. R. R.—*Nature.*

EDWARD TROUGHTON, the celebrated astronomical instrument maker, could never distinguish colours otherwise than by their brightness —a ripe cherry and its leaf were to him of the same colour.

BESSEL.—So expert had Bessel become in cometic calculations (when only 21 years of age), that Olbeis having placed in his hands, on the night of the 1st November, 1805, four observations of the comet of that year, he returned them to him the next morning, with the elements, whose calculation had occupied him only four hours.

SCHUMACHER remarked, "One may almost assert that one exact and able calculation is capable of doing better service to astronomical science, than two new observatories."

THE CORONA.—Dr. Schmidt having asserted that the commonly received opinion of the solar corona being alluded to by Philostratus was unfounded, Professor Grant sends a note to the *Astronomische Nachrichten* (No. 1838), to point out that Schmidt had got hold of the wrong passage. In Book VIII. and chapter xxii. of the said writer's *Life of Apollonius of Tyana*, is an allusion which seems to have escaped Schmidt's notice, and which Grant considers beyond all doubt to refer not only to a solar eclipse, but to specify that attention had been directed to the corona as an incident of the eclipse.

OBSERVATIONS FOR JUNE, 1871.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich midnight	60°N.	0°	60°S.
	Sunrise.		
	°	°	°
1871. June 1	−73·6	−74·5	−75·5
2	−85·8	−86·7	−87·6
	Sunset.		
3	+80·3	+81·1	+82·0
4	68·1	68·9	69·8
5	56·0	56·7	57·5
6	43·8	44·5	45·3
7	31·7	32·3	33·0
8	19·5	20·1	20·8
9	+7·3	+7·9	+8·5
10	−4·8	−4·3	−3·8
11	17·0	16·5	16·0
12	29·2	28·7	28·3
13	41·4	41·0	40·6
14	53·6	53·2	52·9
15	65·8	65·5	65·2
16	−78·0	−77·7	−77·5
	Sunrise.		
18	+77·9	+77·8	+77·6
19	65·6	65·5	65·4
20	53·3	53·3	53·2
21	41·1	41·0	41·0
22	28·8	28·8	28·8
23	16·5	16·5	16·6
24	+4·2	+4·3	+4·4
25	−8·1	−7·9	−7·8
26	20·3	20·1	20·0
27	32·6	32·3	32·1
28	44·8	44·6	44·3
29	57·1	56·7	56·4
30	−69·3	−68·9	−68·6

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JUNE, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight. ° ′	Objects to be observed.
1	18 4·4	Seleucus, Briggs, Lichtenberg.
2	3 50·2	Aristarchus (*a*), Hercynian Mts. (*b*)
20	148 10·3	Mare Crisium (*c*), Apollonius, Firmicus.
21	136 54·9	Cepheus, Franklin, Oersted.
22*	125 27·0	Piccolomini, Riccius, Stiborius.
23	113 43·8	Altai Mts., Polybius, Beaumont.
24	101 42·5	Alfraganus, Theon Senr. and Junr.
25	89 20·5	Palus Nebularum, and P. Putredinis (*d*).
26	76 35·9	Gauricus, Pitatus, Guerikè.
27	63 28·2	Helicon, Leverrier, Euler (*e*).
28	49 58·2	Riphean Mts., Euclides.
29	36 9·5	Gassendi (*f*), Mersenius, Percy Mts. (*g*)
30	22 7·5	Damoiseau (*h*), Aristarchus (*i*), Herodotus.

The lists for February and April may be consulted for additional objects, which will be readily given by the position of the terminator.

* Spring Equinox, N. hemisphere.

(*a*) Compare Browning's drawing at full moon, *Student*, April, 1869, p. 129, and note positions of bright spots near.
(*b*) The enclosed plain has been named "Otto Struve."
(*c*) The direction and form of the central ridges should be well studied.
(*d*) The fine mountain scenery furnishes ample material for close scrutiny and study.
(*e*) An apparently ancient formation, to the east of Copernicus, may be seen on or near the terminator.
(*f*) It is important, in a selenological point of view, to determine the exact character of the central mountains in Gassendi.
(*g*) The mountains between Gassendi and Mersenius.
(*h*) The Rev. T. W. Webb calls attention to a remarkable formation on the N. of Damoiseau.
(*i*) Late observations appear to indicate that the floor of Aristarchus is not *flat*. M. Gandibert calls attention to a valley on the N.W. of Herodotus (see *English Mechanic*, No. 320, May 12, 1871, p. 180), which was observed on May 1, 1871, to be the commencement of the great Serpentine cleft.

Erratum in last list.

May 26. For *Renuker*, read *Rumker*.

ASTRONONOMICAL REGISTER—Subscriptions received by the Editor.

To July, 1871.

Lewis, H. K.

To Sept., 1871.

Buffham, T. H.

To Dec. 1871.

Adams, S.
Crowe, Rev. R.
Green, N. E.
Turberville, H.
Varley, C.

To Jan. 1872.

Shaw, Rev. J.

May 20, 1871. Subscriptions after this date in our next.

ASTRONOMICAL OCCURRENCES FOR JUNE, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon.
Thur	1		Sidereal Time at Mean Noon, 4h. 38m. 6·80s.			10 42·3
		10 19	Near approach of ζ^1 Libræ (4)			
		10 46	Occult. of ζ^3 Libræ (6)			
		11 57	Reappearance of ditto			
		12 1	Occult. of ζ^4 Libræ (6)			
		13 10	Reappearance of ditto			
Fri	2	18 26	○ Full Moon	2nd. Sh. E.	9 0	11 42·0
		7 39	Occultation reappearance of ψ Ophiuchi (5)			
Sat	3	7 6	Conjunction of Mars and β Virginis, 0° 2′ S.			12 45·0
		12 30	Conjunction of Mars and β Virginis, (0·2m.) W.			
		19 0	Conjunction of Uranus and Venus. 1° 46′ N.			
Sun	4	11 39	Conjunction of Moon and Saturn, 1° 28′ N.			Arcturus — 9 14·4
		11 34	Near approach of B.A.C. 6369 (6)			
Mon	5		Sun's Meridian Passage, 1m. 53·90s. before Mean Noon			9 14·24
Tues	6					9 16·5
Wed	7					9 6·5
Thur	8	13 8	Occult. of τ^1 Aquarii (6)			9 2·6
		13 54	Reappearance of ditto			
		14 15	Occult. of τ^2 Aquarii (4)			
		15 24	Reappearance of ditto			
Fri	9	12 37	☾ Moon's Last Quarter			8 58·7
Sat	10					8 54·7
Sun	11		Saturn's Ring: Major Axis=41″·32 Minor Axis=17″·83			8 50·8
Mon	12					8 46·9
Tues	13	14 54	Occult. of B.A.C. 830 (6)			8 42·9
		15 35	Reappearance of ditto			
Wed	14					8 39·0
Thur	15	12 43	Conjunction of Moon and Mercury, 0° 20′ S.			8 35·1
			Illuminated portion of disk of Venus=0·648			
			„ of Mars=0·883			

DATE.		Principal Occurrences. h. m.		Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
Fri	16		Sidereal Time at Mean Noon, 5h. 37m. 15·17s.			8 31·1
Sat	17	14 29 12 0	● New Moon Conjunction of Mars and η Virginis (10 2m.) E.			8 27·2
Sun	18	9 20	Conjunction of Moon and Jupiter, 0° 29′ S.			8 23·3
Mon	19	23 50	Conjunction of Moon and Uranus, 1° 41′ S.			8 19·3
Tues	20		Sun's Meridian Passage, 1m. 8 13s. after Mean Noon			8 15·4
Wed	21	11 59	Conjunction of Moon and Venus, 1° 43′ S.			8 11·5
Thur	22					Moon. — 3 38·5
Fri	23					4 26·0
Sat	24					5 12·7
Sun	25	10 44 7 10	☽ Moon's First Quarter Conjunction of Moon and Mars, 5° 36′ S.			5 59·1
Mon	26					6 46·3
Tues	27	8 32 9 42	Occultation of 94 Virginis (6) Reappearance of ditto			7 35·3
Wed	28	7 15	Opposition of Saturn			8 27·4
Thur	29					9 23·4
Fri	30	4 14	Conjunction of Jupiter and the Sun			10 23·7
JULY. Sat	1	10 23	Conjunction of Moon and Saturn, 1° 16′ N.			11 27·4

THE PLANETS FOR JUNE.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	3 16 19	+ 14 6½	9″·8	22 34·5
	15th	4 3 27	17 52½	7″·2	22 26·5
Venus ...	1st	7 32 5	+24 2½	15″·5	2 53·5
	15th	8 38 34	20 39½	17″·3	3 4·7
Mars ...	1st	11 41 42	+2 50	11″·3	7 2·4
	15th	11 59 43	0 28	10″·1	6 25·4
Saturn ...	1st	18 36 33	−22 23½	16″·6	13 56·2
	15th	18 32 33	22 28	16″·6	12 57·1

Mercury is a morning star during the month, but too close to the sun to be much worth observing.

Venus is well situated for observation.

Mars is visible throughout the night till early morning. On the 25th he sets twice, and for the rest of the month sets before midnight.

Saturn rises between sunset and midnight till the 24th, when he rises at sunset, after which date he will rise before sunset and be visible throughout the night.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham Honse, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

APPENDIX TO THE *ASTRONOMICAL REGISTER.*

No. 102.

READINGS FROM THE BORGIAN GLOBE.

(See *Astronomical Register*, No. 97, January, 1871.)

A CAREFUL examination of the planispheres in Asseman's work proves them to have been very faithfully executed. Notwithstanding the frequent ambiguity or obscurity of the Cufic letters, many names are readily made out; and even the tracings of such as are doubtful often suggest an almost certain emendation of some of the readings of Asseman. The general result shows an almost perfect accord between the names in Ulugh Beigh and other authorities, and those on the globe. That many words are nearly alike, especially when not clearly written, in Arabic, which are unlike in Roman characters, will be borne in mind by the reader in perusing the following notanda. Explanations of names not given here will be found in "Arabic names of the stars, &c." in No. 97. An asterisk is affixed to names not included in that list. A. stands for Asseman.

URSA MAJOR. ξ *Alhiac*, the ostrich (A.), is probably *al-'anák.* η *Alcatel*, the slayer (A.), is very probably *al-kaid.* ϵ, *alhút*, the great fish (A.), is very probably *al-jaún*, or *al-hawar*. The unformed stars, since made by Hevelius into Leo Minor, are enclosed in a pear-shaped figure, and named *aldhibá wa auládhuha,** the antelopes and their young; as Smyth also notices, *Cycle*, vol. 2, p. 248. To one of them A. reads the name *al-shaukat*, the thorny plant, or *mabsutah*, stretched out, but the reference is mistaken, and the words are plainly *dhirá'-al-mabsutah*, and relate to Gemini. 12 and 8 in Canes Venatici (a constellation made by Hevelius) are enclosed in a little parallelogram, to which A. reads *Karab-al-abl*, the camel's pack, but which very probably is *Kabd-al-asad.*

DRACO. A. reads the name *Alghavil altannin*, and makes it to mean the poisonous dragon. The first word, however, is *al-'awáyid*, and refers to the stars in the head only. μ, *alcaab* (A.), the dish, is probably *al-rákis.* β, *al-zahr* (A.), the flower. Jauhari (Anglice, "Jeweller"), the compiler of the Arabic Dictionary called *Sahah*, accurate, says *Jauzahr* is the Arabic form of the Persian *Kúzahr*, meaning the place of poison. Perhaps *zahr* on the globe is part of this word put for the whole; though *zahr* (poison) is really Persian. Both *Jauzahr* and *Kúzahr* are used in Persian for the dragon's head and tail. In the first fold of the dragon's neck A. reads *algharanec*, the cranes. The word, however, is *alfirk*, and belongs to Cepheus, whose left side is entangled by the folds of Draco, in the planisphere. ι, *al-rubah*, the camel's foal, or *al-dhík*, the wolf (A.),

who prefers the latter, and it seems to be the better reading. Three other names, which A. could not make out, seem to be ζ, *al-dhib*, the wolf; over η, *al-dhíbain*, the two wolves or jackalls; *al-atháfí*, one of the stars of the tripod.

Boötes. According to Hyde, *al-'auwá*, the shouter, was owing to a misapprehension of the Greek name, as though it was derived from boân, to shout. (There is a Greek word, boátes, crying.) κ, θ, ι, λ, *aulad al-nadhlat*, the children of contention (A.) is *aulád al dhiba'*; the Cufic, however, as in other cases, might easily be mistaken for A.'s reading. ε, *almizat*, reaping hook or curved weapon (A.), obscure; probably *mízar*, girdle. η, *al-ramh*, the spear. α, *al-rámih*, the lancer.

Corona Borealis, α, *munír-min alfekkah*, the bright one of the platter.

Hercules. *Al-játhí fainnahu al-rakis*, "the kneeler," and he is also "the dancer" (A.) But the last three words are *'alá rukbeteihi*, on his knees. On the right arm, however, of the figure, are the words *wa al rakis*, and the dancer, not mentioned by A., but evidently a continuation of the preceding inscription.

Lyra. Figured as a kind of ornament, or arabesque, something in the form of a tortoise. It has an inscription for which A. proposes three different readings, none of which are very probable. One is *almozafzef* (a bird) with wings partly extended, letting itself down gently. The word appears to be *al-migrafat*. α, *al-wáki'*.

Cygnus. *Al-ornis*, from Gr. ornis, the bird. α, *Ridf*.

Cassiopeia. β, *al-'azizat*, the exalted one (fem.) (A.). I suspect it is *Kaff-al-khadib*.

Perseus. Over the left shoulder, A. reads *mughammedh al thuraiya*, or *mukhammer al thuraiya*, both meaning, concealer of the Pleiades, or the Many; but I think the first word is *mi'sam*. ο, on the right heel, *sabik al thuraiya*, preceding the Pleiades (A.), but it may be *'átik al thuraiyá*.

Auriga. A man holding a scourge or whip. *Mumsik-al-'ainnat*, holder of the reins. α, A. reads *alcabelah*, as if for Capella; but as a derivation from the Latin is unlikely, he also proposes two other readings. I am disposed to think the word is meant for *al-'ayyúk*, or possibly *al-'atúd*, the kid. ε, *al'anz*,* the she-goat (by others called *al-ma'z*, the goats). η, *al-hurr*,* the fawn.

Ophiuchus. To a conical figure between the left arm and Aquila, containing Taurus Poniatowski, is an inscription which A. was unable to read. I can only surmise it may be *al-rá'í-wa-Kaikas*, the shepherd, and Kaikas, the last word a corruption of Ophiuchus, to whom the inscription relates. A. could find no name in this constellation, but I think *al-ráa'í*, may be read over the head of the figure.

Aquila. In a triangular figure are five stars, afterwards Antinous, of which to δ and λ, A. reads *al-khalimain*, the two friends; but Smyth correctly has *al-dhalímain*,* the two ostriches. *Cycle*, vol. 2, p. 431.

Delphinus. A. has overlooked a word which seems plainly to be *al-'ukúd*, the knots, or necklaces, among the four stars.

Pegasus. θ. *Sa'd-al-melik* (A.) very indistinct, is perhaps *sa'd-al-baháim*. *Sa'd-al-melik* is properly α Aquarii about 7° below. α, *mokaddem*, for the full form. τ and υ, *almanar* (A.), I believe the true reading is *al-kereb*. A. remarks that the mishapen and confused lettering in Pegasus renders it impossible to do more than conjecture its meaning, but upon the whole he has been very successful.

Andromeda. ν, *alaamac* (A.), is *al-a'nák*. β, *batn al-hút*, referred by A. to Pisces, seems to belong to Andromeda in the planisphere. α, *al-sarrat*, the navel, plainly written, though not noticed by A. Three straight lines, and the hinder part of Pegasus mark off a space in which is α

Andromedæ and γ Pegasi, and *al fargh al-muachchir*, is written between them. Half of the head of Andromeda is included in this space.

Taurus. Aldebaran is called also *alfaník*,* the camel or horse-stallion. Hyades, called also *alkaláïs*,* the young camels. (Alferghani.)

Gemini. ϵ, *al-dhira* (A.) should be *al-dhirá' al-mabsútah* (see under Ursa Major).

Cancer. Præsepe, *al-nathrah* is called also *Fom al-asad*,* the lion's mouth. (Alferghani.)

Leo. *Al-tarf*,* the eye; two small stars called also *'aïn–al-asad*,* the lion's eye (Alferghani). 12 and 13 (6th magn.) occupy this place in our maps. Tizini calls λ the northern one of *al-ta·f*, and κ the northern one of the nostrils.—*Note.* κ is *minchir-al-asad*, according to Ulugh Beigh, not λ, as I before wrote. *Al-tarf* may possibly have been λ and κ. *Al-jabhah*, ζ, γ, η (Ulugh Beigh), including Regulus (A.). Smyth remarks that γ is improperly so called; "for," he says, "no representation of the lion which I have examined will justify that position." There seems to have been some variation or confusion in this asterism. Perhaps *jabhah* means here the front generally, rather than the forehead. δ and θ are also called *al-khárátan*,* the guides (?) (Alferghani).

Virgo. a, *alaghzal* (A.) should be *al-'a'zal.*

Sagittarius. *a'ïn al rámí*,* ν^1, ν^2 (?), eye of the archer, "a nebulous pair" (Ulugh Beigh). *'Urkúb-al-rámí*,* β, the hough or pastern of the archer (so Ulugh Beigh). δ, *al-wasl*,* the joining or union; perhaps of the hand and the bow; or of the cusp and the shaft; or if the name is ante-Ptolemaic, it perhaps signifies the place where the two herds met, coming to and returning from watering. *Al daffa al rámí*, referred by A. to a star in the off foreleg. ϵ, or β, Telescopii (?), and explained by him as "the half of the archer." But it may be an error for some other word, perhaps *al nasl al-rámí*, and seems to refer to γ in the planisphere. A. has not noticed a word on the hind-quarters, which I read *al-'azaízá*,* the buttocks, probably 62. *Al-buldat*,* the city, the space between the archer's shoulders and the horns of Capricorn.

Capricorn. *Shát*,* a sheep, would seem to be π, but according to Ferghani it is a^1, the smaller star close to a^2, the northern *Dhabih*, or slaughterer. δ, *Dheneb al-jedí*,* the goat's tail (Ulugh Beigh).

Aquarius. a, A. has *sa'd-al-kol*, a misreading for *sa'd-al-melik*. I think I read *dalw*, or *al-dalw*, over the urn. Fomalhaut is included in this constellation. In characters unusually large and clear, it has the inscription, *al difda' al awal wa huwa al dhalím*, the first frog, which is also "the ostrich."—*Note.* δ. Skat (maps) may after all be for *sák*, the leg or shank.

Cetus. A. reads *al baka*, among the stars in the body. It seems to be *al-na'ámát*, the ostriches.

Orion. a, *yed-al-jauza*,* hand of the Jauza. γ, *al-dahar* (A.) seems to be *al-nájid*. π^1, π^2, &c., *al-dawáir* (A.), the circles, should be *Dhawáib*, forelocks.

Eridanus. a, *ákher al nahr wa huwa al dhalím*, the end of the river, which is also "the ostrich," in clear bold letters. *Al kaff al jeria* (A.) who refers it to the bend in the river; but it refers to γ Ceti, and is *kaff-al-jidhmá*. The words Angetenar, or anchenetenar, mentioned by Cœsius, may be a corruption of some word like *mahniyat-al-nahr*, the bend of the river; perhaps η.—*Note.* Theemin (maps) the eighth, perhaps marks the 8th bright star in the river, beginning with a. 8 are laid down in the planisphere.

Lepus. A word beneath the hare's feet, very illegible, may be conjectured to be *nihál* or *kursá.*

CANIS MAJOR. *Aloori* (A.) is *al-a'dhára*, η, ϵ, &c. α, *al-yemaniyah al a'búr*, the Yemanite, the crossing; called also *Kelb-al-jabbar*,* the giant's dog. (Abdurrahman Sufi.) *Al-furúd* is inscribed in a quadrangular figure, enclosing seven stars of the unformed of Canis Major, since made into Columba, not including ζ.—*Note.* Phaet (maps) may possibly be a corruption of *furúd*.

CANIS MINOR. α, *al shámiyah al ghomeisá*, the Syrian, the watery-eyed.

CORONA AUSTRALIS. Described by A. as without any of the embellishments of the other constellations, and "as if thrown down at the feet of Sagittarius." Thus Germanicus spoke of it as "sine honore corona," for no legend was attached to it. 150 years later, Ptolemy gave it its present name, which when the globe was made had the respectable antiquity of above 1,000 years; yet the configuration of its stars, and the name, without any drawing, is all that was allowed it. It would be desirable in our own maps and globes, when the delineations of the figures of the ancient constellations are given, that they should be presented with scrupulous accuracy; but all others may well be omitted, retaining only the names and boundaries as given by Hevelius, La Caille, and others. In the standard lists of the constellations in Hind's *Astronomy*, and in Chambers' *Descriptive Astronomy*, a quantity of rubbish introduced into the heavens in later times has properly been rejected.

The number of names on the Borgian Globe, after revising A.'s readings, is 138, allotted as follows:—Pegasus, 11; Ursa Major, 10; Draco and Sagittarius, 8 each; Aquarius, 7; Boötes, Orion, and Canis Major, 5 each; Cepheus, Perseus, Auriga, Andromeda, Leo, Capricorn, 4 each; Hercules, Aries, Virgo, Scorpio, Cetus, Ursa Minor, 3 each; Lyra, Cygnus, Cassiopeia, Ophiuchus, Delphinus, Taurus, Gemini, Eridanus, Lepus, Canis Minor, Argo Navis, Centaurus, 2 each. The rest have 1 each, except Sagitta, Equuleus, and Lupus, which have none.

GEORGE J. WALKER.

The Astronomical Register.

No. 103. JULY. 1871.

GREENWICH OBSERVATORY.

The annual visitation of this establishment took place on the 3rd of June, and, as usual, the day being fine, a large and distinguished party assembled, to see the instruments and talk over the science topics of the day. It is well said that these meetings are in effect astronomical *conversazioni*. Some join them to see people; others, to see things. The whole of the instrument rooms are thrown open; all is put in exhibition order. There is a great deal to be looked at; and he who looks carefully and gives any attention to the report of the year's labours, which at the close of the day is put into his hands, will come to the conclusion that there are few Government establishments out of which such a mass of earnest and valuable work is wrought in return for a sum so mean as that which appears in the Navy Estimates as the portion voted to the Greenwich Observatory.

In regard to the instruments, the Astronomer Royal reports that:—

"The transit circle is now in perfect working order; the object-glass was cleaned in January by Mr. Simms. Some difficulty having been experienced in the use of the finder, owing to the want of illumination of the field, a reflector has been added, which, by giving a distinct view of the wires, has proved of great use in cases where the circle had to be read off before the time of transit. The correction for level-error in this instrument having become inconveniently large, owing apparently to a gradual subsidence of the eastern support since the erection of the instrument, about a ton weight of stone was placed on the pier in August last. Not the slightest change, however, could be traced as due to this; the level-error maintaining its usual value. This plan having failed, the stones were removed on November 19, and a sheet of very thin paper, $\frac{1}{270}$ inch in thickness, was placed under the eastern Y, which was raised from its bed for the purpose. The collimators having been observed just before this operation, no difficulty was experienced in adjusting the instrument so as to

have very nearly the same error of azimuth as before. The mean value of the level-error appears to be non-sensibly zero. Two of the vertical wires having been found broken, Mr. W. Simms replaced them on January 18, and at the same time inserted a new horizontal wire, so as to reduce the inclination, which for the old wire was rather large. A re-determination of the astronomical flexure of the telescope-tube, in the early part of this year, from two sets of measures made at widely different temperatures, leads to a result differing by 0·25″ from that previously found. The individual results are so accordant that I have thought myself justified in adopting this value for use in the present year. In April an examination of the form of the pivots was made, which seems to show there is no sensible deviation from circularity. As to the altazimuth, it is in good order. On January 20, 1871, the insulation of all the galvanic parts was renewed by Mr. Simms, using ebonite instead of gutta percha; the registering apparatus is now in better order than ever before. At the same time a new system of wires was inserted in the field of view of the telescope, having the middle interval larger than others, for convenience of identification on the chronograph sheet. The object-glass was taken out and cleaned on May 3. No alteration has been made in the levels, the artist apparently having been unable to perfect the construction to which I alluded in the last report. Gas-burners are fixed for illumination of the microscopes of the horizontal circle. The new water-telescope, already described in the *Register*, has been got in working order, and performs most satisfactorily. There are some interesting observations with regard to chronometer communications of time, etc., which are worthy of record in our columns. There are at the present time 202 chronometers in the chronometer room; of which 123 box-chronometers, 21 pocket-chronometers, and 13 deck-watches are the property of the Government; 1, belonging to an officer of the Navy, is on trial for purchase; and 44 are placed here by chronometer-makers to take part in the annual trial. The chronometers are compared with a mean solar clock—some every day, some every week, sometimes in high temperatures, and sometimes in different magnetic positions, as usual. Though the average of the trial numbers for the first six chronometers, in the last competition, shows a slight falling off in their merits, as compared with the preceding year, one of the number was of unusual excellence. The performance of chronometers, as depending on their mechanical construction, is very admirable. I have remarked but one point in which I could desire change—namely, that the balance should be struck more lightly, at a greater distance from its axis. The late Mr. Charles Frodsham, at my suggestion, had made some experiments on this point which promised to be successful. The principal errors, of even moderately good chronometers, are, however, produced by defective compensation, which the most skilful maker cannot perfectly manage. I have long been of opinion that the final adjustment for compensation ought to be made by some more delicate operation than that which suffices for approximate compensation; but the able chronometer-makers whom I have consulted have not yet devised a satisfactory plan. Allusion was made in the last report to a plan for securing the balance of a chronometer from injury in its transit by rail or otherwise. Nothing quite satisfactory has yet been proposed by any of the chronometer-makers who have turned their attention to this subject. Chronometers have been selected, as usual, for purchase by the Admiralty, and occasionally for foreign men of science. With regard to the personal establishment, the Astronomer Royal is responsible to the Government and the public for all transactions within the Observatory; the repairs and extension of buildings; the care

of the property of the Observatory; the daily discipline, the planning of the instruments, observations, calculations, and publications are under his superintendence. The office of Chief Assistant was held by Mr. Stone till the summer of 1870, when he was appointed to the charge of the Cape Observatory. He was succeeded in this Observatory, in the autumn, by Mr. William Henry Mahony Christie, Fellow of Trinity College, Cambridge. Mr. Glaisher superintends the Magnetical and Meteorological department; Mr. Dunkin now controls the staff of supernumerary computers in the Astronomical Department; and, as senior assistant, is relieved as much as possible from severe observations. Mr. Ellis takes charge of the Time Department (chronometers and galvanic communications); Mr. Criswick, of the Circle Reductions; Mr. Lynn, of the Altazimuth; Mr. Carpenter, of the Equatoreals, the arrangement and safety of the Library and MSS., and the distribution of printed works; Mr. Nash, under the direction of Mr. Glaisher, is engaged with work incidental to the Magnetic and Meteorological department. These gentlemen are considered as permanent assistants, borne by name on the books of the Admiralty. From a sum of money placed at my disposal by the Admiralty, stipends are provided for six supernumerary computers in the Astronomical Department (increased to seven during the absence of Mr. Carpenter at Oran, for observation of the total eclipse of December 22, 1870), and for three in the Magnetic and Meteorological Department; and by these (who for the most part are very young men) a large proportion of the daily work of calculation is performed." The Astronomer Royal adds:—"I cannot speak too highly of the zealous and orderly conduct of the assistants generally.

"The occurrence of the total eclipse of the sun in December last, has brought much labour to the Observatory. As regards myself, the antecedent work in reference to general observers, the preparations for the Greenwich Observations, and the undertaking (which I found difficult to avoid) of some degree of superintendence of general report, have greatly occupied my time. As regards the assistants and computers, the actual observation on a complicated plan with the great equatorial (a plan for which few equatorials are sufficiently steady, but which, when properly carried out, gives a most complete solution of the geometrical problem) has required in observation and computation, a large expenditure of time. At the request of Mr. Huggins, and with the sanction of the Admiralty, Mr. Carpenter was detached to assist in observations at Oran, a valuable assistant was thus withdrawn from the routine work of the Observatory. My own time has been partly occupied in preparations for the Transit of Venus, 1874. I have taken measures for equipping each of the five stations with a transit, an altazimuth, and an equatorial of transits. I have five now, all mounted on stone piers. Of clocks to accompany them, I have two from the Royal Observatory, three new. Of altazimuths, I have one from the Royal Observatory, four new. Of equatorials, 6-inches aperture, and carried by clock-work, I have five, purchased or new. Of clocks of an inferior class, to accompany the two last classes of instruments, I can supply only one, and must procure nine. Fifteen portable observatories must be prepared, of which I shall be able to exhibit specimens to the visitors. The Royal Observatory can supply three 4-inch detached telescopes, and two more will be desirable. My preparations have respect only to eye-observation of contact of limbs. With all the liabilities and defects to which this is subject, this method possesses the inestimable advantage of placing no reliance on instrumental scales. I hope that the error of observation may not exceed four seconds of time, corresponding to about 0·13″ of arc. I shall be very

glad to see in a detailed form a plan for making the proper measures by heliometric or photographic apparatus, and should take great interest in combining these with the eye-observations, if any selected stations can be made available. But my present impression is one of doubt on the certainty of equality of parts in the scale employed. An error depending on this cause could not be diminished by any repetition of observations. As in the event of any national enterprise being promoted in the direction of photographic record, it is probable that the Astronomer Royal may ministerially take an important part, I venture to submit to the Board of Visitors that suggestions on the value and plan of such observations fall entirely within their competence. Several gentlemen of the corps of Royal Artillery have expressed their wish to take part in the observations of the Transit of Venus, and I proposed to give them opportunities of making adjustments, etc., of instruments, in the same manner as in the actual observations. I trust they will be joined by officers of the Royal Navy."

In concluding the report, the Astronomer Royal adds, that "The catalogue of stars from Bradley's old observations is now drawn out in manuscript, and is in his hands for examination and final decision upon the use to be made of it." He also makes the following general remarks: "I have adverted in my last report to the advantage that might be obtained if the attention of the chief of the Observatory could be in some measure withdrawn from the routine and manual labour of the office, and could be allowed to expand itself more freely in the direction of physical investigations, and, perhaps, of scientific literature; although the time is far advanced, I do not abandon all hope of making some progress in these subjects. This will, however, imply the delegation (under instructions) of much work which I have been accustomed to do myself; and that change will be felt in all employments, down to those of the youngest computer. In the ordinary conduct of an Observatory of this class, as applying both to its scientific observations and to its civil services, there is little difficulty (although much labour) in maintaining general regularity. As illustrating this, I may remark, that the current reductions of observations, in spite of formation of seven-year catalogue, solar eclipses, and preparations for Transit of Venus, are in as healthy a state as they have ever been in, and these regular reductions give, in general, great facility for the most advanced inferences; the star catalogues, and solar, lunar, and planetary errors, lend themselves immediately to investigations of a physical character; the magnetic reductions distinctly, though tacitly, exhibit some of those results (for instance, annular irregularities) which in various observatories have been the subject of special memoirs. But from time to time it becomes desirable to unite some of those annual, or nearly annual results in groups, so as to exhibit the results justly derivable from masses of observations extending over long periods of years. These operations require new organisations, and, what is worse, they require additional grants of money. I have usually refrained from asking for these without the distinct approval of the Visitors. I would now submit for their judgment the following subjects:—

"The vigorous prosecution of the meteorological reductions (exhibiting the results reducible from the photographic registers) already begun. The combination of the results of magnetic observations on undisturbed days, from the year 1864. The discussion of magnetic storms, from the year 1858. Perhaps also the discussion of observations in groups depending on lunar declination, or other phases. There is another consideration which very often presents itself to my mind: the waste of

labour in the repetition of observations at different observatories. The actual Greenwich system was established when there was little to compete with it; other observatories have since arisen, equipped with and principally using the same classes of instruments, and devoting themselves in great measure to the same subjects of observation (except the unrelenting pursuit of the moon, and perhaps the fundamental elements of the Ecliptic), ought this Observatory to retire from the competition? I think not, believing that there is greater security here than anywhere else for the unbroken continuity of system, which gives the principal value to series of observations. Still, I remark, that much labour is wasted, and that, on one side or another, that consideration ought not to be put out of sight in planning the courses of different observatories."

The *Daily Telegraph*, at the end of an able article upon the Visitation, says, with respect to the coming Transit of Venus—

"There were the important preparations for the Transit of Venus over the sun's disc in 1874. This rare phenomena offers an opportunity of determining a most fundamental astronomical datum—the distance of the sun; and the astronomers of all nations are making preparations for its observation. England is taking the lead, thanks to the energetic foresight of the Astronomer Royal, who formed his plans two or three years ago, decided upon the stations, five in number, to be occupied by British observers, obtained the Treasury authority for the expenditure of 10,000*l.* upon the observations, secured a portion of the grant for immediate disbursement, and forthwith began to purchase and plan the requisite instruments. Each station will have three observatories: one containing an equatorial of 6-inches aperture, another a transit of 4-inches aperture, the third an altitude instrument. The last two will be for determining the latitude and longitude of the station, and for obtaining accurate time: the first will be used for observing the phenomenon. Clocks and smaller telescopes will complete the equipment of each station. On Saturday specimens of each instrument were shown, the transit and altitude instruments being mounted in their portable observatories ready for the practice of those who will make the observations. We believe the observers will be scientific officers of the army and navy, several of whom have already volunteered their services. The five British stations at present selected are Alexandria, Honolulu, Roderiguez Island, Auckland, and Kerguelen's Island.

"After the deliberations of the Board of Visitors, a large section of the party, following a good custom, betook themselves to the 'Ship,' for gastronomical pleasures."

We understand that the Visitors of the Royal Greenwich Observatory have decided to recommend the Government that photography should be used in the coming Transit of Venus, and that they will advise that 5,000*l.* should be voted for the purpose.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Eighth Meeting, June 9th, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The President read to the meeting a letter from Lady Herschel, acknowledging the address of condolence and sympathy passed by the Council, and reported in our last number.

The minutes of the last meeting were read and confirmed.

Thirty-seven presents were announced, and the thanks of the meeting given to the respective donors. Attention was particularly directed to a *Memoir of the Indian Surveys*, by Mr. Clement Markham, giving a most interesting account of the progress of those operations, and to a series of photographs of the last solar eclipse, taken at Cambridge, by Professor Selwyn, in which the exquisite definition of the solar spots and faculæ was very remarkable.

John Brett, Esq ,
Rev. A. Robertson, and
Rev. Reginald F. Dale,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read :—

Observations of Winnecke's Comet: by the Rev. S. J. Perry.

The occurrence of bad weather had prevented observations of this comet until it was so near the sun as to be very indistinct, although it was still more conspicuous than the comets of 1870. The star ι Aurigæ had been selected as the star of comparison, but on some occasions an intermediate double star had been used, to diminish the chances of error.

The observations of May 8, 9, and 10 were given in detail. Those of May 11 and 12 were unsatisfactory, on accouut of clouds and the object being near the horizon.

Occultation of 80 *Virginis by the Moon, on May* 30: by Capt. Noble.

The star disappeared instantaneously at the moon's dark limb, at 14h. 25m. 5s. L. S. T. = 9h. 53m. 13·9s. L. M. T., and reappeared at the bright limb from behind a dome-shaped mountain at 15h. 14m. 48s. L. S. T. = 10h. 42m. 48·8s. L. M. T. The times are good, though the atmosphere was unsteady. Power 255 on 4·2 inch equatorial.

Capt. Noble added, orally, that he wished to draw attention to the fact, that the star emerging from behind the projecting mountain was a fraction of a second later than it would have been from the uniform outline of the limb, and that an observer at a distance might have escaped this through parallax, introducing a possible element of error in a calculation of longitude.

Mr. Dunkin pointed out that had the star appeared at the bottom of a depression, the reappearance would have been accelerated.

The Astronomer Royal said, the same thing happened at eclipses of the sun, and he remembered that in 1851 the mountains of the moon reached the sun's limb as much as three seconds of time before it was entirely shut out at the bottom of cavities, and that this was the cause of Baily's beads.

Professor Pritchard said that the curious appearances seen at such phenomena were strictly speaking the result of an effect of the interference of light, sometimes called irradiation, whereby a false edge was given to any bright object to which an opaque body made an appulse. He did not think mountains and cavities entirely concerned in the question of Baily's beads. Mr. Baily himself described not only beads but black ligatures, connecting points on the sun and moon, and ending in the formation of the beads. Upon going further into the matter, references would be found to the peg-top appearances at the Transit of Venus, and if such appearances were not always seen they ought to be theoretically, and would be if looked for with a small aperture and deep eyepiece; that is, the microscope with which the object-glass image is observed must be a powerful one. The appearances were perfectly consonant with the undulatory theory of light, and accounted for by physical optics. He hoped observers of the Transit would look at it for these phenomena with small apertures and deep eyepieces.

The President remarked that small aperture and high magnifying power were most unfavourable conditions for the observation of the Transit.

Professor Pritchard: But you cannot see phenomena of interference without. It is not the astronomical observation I am speaking of, but the curious effect of the appulse of two bodies of different brightness.

The President: Then this arises from imperfect vision.

Professor Pritchard: No, no. Theory says the appearances must be there. They are not subjective phenomena, but the most objective things in creation. No one knows this better than the Astronomer Royal, who has calculated all these things. Every bright object has a spurious edge.

The discussion seemed likely to continue, but it was pointed out that time was precious, and the matter hardly relevant to the paper. It was also evident that while the President was advocating large aperture, and low power, so as to see the Transit as free from optical defects as possible, Professor Pritchard was pointing out how to produce the embarrassing results in the greatest perfection purely for optical purposes.

On the Expression of Delaunay l g h, in Terms of his finally adopted Constants: by Professor Cayley.

The author gave an oral account of the object of this paper.

On the Initial Velocities of the Planets: by Mr. Abbatt.

This paper gave the initial velocities of the planets, calculated from their known elements, as compared with velocities which would have projected them in parabolas or hyperbolas, instead of their present orbits, and the results were adduced as evidences of design in the formation of the solar system. The figures given were as follows :—

Mercury	29	miles in a second	to produce	an ellipse,	40	for a parabola.
Venus	21	,,	,,	,,	30	,,
Earth	18	,,	,,	,,	26	,,
Mars	14	,,	,,	,,	21	,,
Jupiter	8	,,	,,	,,	11	,,
Saturn	5	,,	,,	,,	8	,,
Uranus	4	,,	,,	,,	5	,,
Neptune	3·3	,,	,,	,,	4	,,

The rule does not apply to the Asteroids, as the table showed. They appear to serve other purposes, and were probably introduced in a different way.

Some discussion ensued on this paper: Capt. Noble contending that as we did not and could not know the real initial velocities and circumstances of projection, such calculations were useless; and Professor Pritchard warmly defending such speculative researches as sometimes leading to important results.

On Physical Changes in Jupiter: by Mr. Ranyard.

It having been suggested that the changes recently described were due to the superior instruments now employed in the observations, and that had the planet been studied with similar telescopes formerly, the same appearances would have been seen, the author of this paper discusses the drawings of Jupiter made within the last 20 years with telescopes of large aperture, with a view to show that changes have always been remarked in the peculiar spots and markings, and that there is a connection between such appearances and the sun-spot period. The first is a drawing by Mr. Lassell, made with 2 feet of aperture (reflector) and showing white spots. This was two years after a sun-spot

maximum. The next is by Dr. De la Rue, in 1856, very near a sun-spot minimum. It was made with 13 inches of aperture (reflector), and shows no traces of the *Dawes* markings or white spots. Another picture, made by Piazzi Smyth on Teneriffe, with a 7¼-inch refractor, agrees entirely with De la Rue's and has no white markings, eggs or loops. Mr. Lassell again, in 1859, approaching a spot maximum, figured the eggs and white markings, and says he had failed to see these spots for many years, but that latterly they had appeared again. In 1861, Sir W. Keith Murray contributed some very beautiful drawings with a 9-inch refractor, showing the spots and markings in question, and other observers have since seen them with apertures of 5-inches and upwards. In 1860, the Report of the Greenwich Observatory states that with the great Equatorial, Jupiter presented appearances not previously recorded, and that Mr. Carpenter had made a series of careful drawings of the planet. The author stated that Mr. Carpenter mentioned to him that Sir W. K. Murray's drawings were almost identical with Mr. C.'s, and showed the same floculent portholes, elliptic markings and colour of the central band. At the next sun-spot minimum in 1866, there are not many drawings, and none of them remarkable, but the markings have now reappeared. If the earth were viewed from a distance, at our sun-spot maximum, the auroras then most prevalent might give a perceptible tint to parts, but they would be near the Poles. There might be similar phenomena producing equatorial changes on Jupiter.

On a New Solar Eyepiece: by Mr. Browning.

The instrument, which was described by Mr. Browning, had been introduced to his notice by Mr. Ranyard, and had been contrived by Professor Pickering. Mr. B. was so pleased with it that he made a rather imperfect one, which he exhibited to the meeting. It consisted of two prisms cemented together at their hypothenuses, and most of the light falling on this was transmitted, but enough was reflected to pass through the ordinary Huyghenian eyepiece, and being also polarized, a Nicol's prism was mounted as an analyser, and being turned round admitted just as much light as was desirable. With the light shut off, faculæ were seen bright on a dark ground, while on a spot, by admitting a little more light, the detail could be admirably studied. Of all solar eyepieces, Mr. Browning had found it the most agreeable in use.

On the Total Solar Eclipse of December, 1871, *on the Australian Continent*: by Mr. Hind.

The author finds that the duration of the eclipse will be much longer on the northern coast of Australia than in India, the

totality exceeding four minutes in most places, as compared with two minutes in Southern India. He has selected five stations, and calculated the times and totality. The places are Vansittart Bay (S. extremity), Mount Casuarina, Pearce Point, Groot Eylandt (S.E. extremity), and Cape Sidmouth. These places are not colonised, but it may be desirable to send observers from Sydney or Melbourne.

On Auroral and other faint Spectra under small Dispersion: by Professor Piazzi Smyth.

The meeting was then made *special*, to consider the following proposed new bye-law:—

In Section XVI. add—

"75* Notwithstanding the preceding bye-laws, in cases where two or more persons have been jointly concerned in the production of any scientific treatise, or the carrying out of any research, work, or discovery, or have been the simultaneous but independent authors of any such treatise, work, research, or discovery, the Council may, under these circumstances, receive the nomination of such two or more persons as joint recipients of the Medal, and proceed thereupon in like manner as above-mentioned with respect to the names of separate persons; and should the Medal be ultimately awarded to such joint authors, workers, or discoverers, an impression of the Medal shall be provided for and given to each of such joint recipients."

The adoption of the new bye-law was moved by Professor Pritchard and seconded by Dr. De la Rue. They explained that it was intended to meet the case of conjoint work, like that of Huggins and Miller, or Lockyer and Frankland, on the one hand, and independent discoveries like those of Le Verrier and Adams, or Jansen and Lockyer, on the other, which at present could not be legally rewarded with the Medal.

The Astronomer Royal and Mr. Vignolles having addressed the meeting in support of the motion, it was carried *nem. con.*

The meeting then adjourned.

The Sheepshank's Astronomical Exhibition at Trinity College, Cambridge, has been awarded to Horace Lamb, scholar of the College. The exhibition is open to all members of the university, the only condition being that the person elected shall become a member of Trinity College.—*Nature.*

Our readers will be sorry to hear that the Paris Observatory has suffered much from the miserable revolution. According to M. Marie-Davy and M. de Launay, it seems to owe its partial preservation to no good feeling on the part of the Commune, who contemplated its entire destruction.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MR. NEWALL'S GREAT REFRACTOR.

Sir,—I had for some years intended to send my 25-inch telescope, when finished, to Madeira, for the sake of a better atmosphere and a more southern latitude; but as the completion of it has been delayed so much longer than I ever anticipated, I have now decided to keep it in England, and as the smoky atmosphere of Gateshead is not fit for astronomical work, I now think of removing it to the South of England.

I should like to take the advice of astronomers who live in the south as to the best locality, and will feel much obliged by communications on the subject. I imagine that some of the high ground in Surrey or Kent would be the best.

I am glad to say that Messrs. Cooke have at last finished graduating the circles, and the eye end is promised next week. The micrometers and illumination will, I hope, be completed without much further delay, and then we may look for some good results; but eight years is a long time to wait for this, which ought easily to have been accomplished in a much shorter time.

I am, sir, yours truly,
R. S. NEWALL.

Ferndene, Gateshead: 20th June, 1871.

DESIDERATA.

Sir,—May I be allowed to jot down a few things for which I conceive a need to exist, and the mention of which may possibly cause such need to be supplied?

Imprimis, then, in these days of five pound telescopes and five pound microscopes, I do not see why a five pound sidereal clock should not be produced. The face should, of course, be divided round the whole twenty-four hours, and the pendulum (which might consist of a deal rod with leaden bob for compensation) beat seconds. The train of wheel-work being the only really important part of the affair, it would matter literally nothing how common and plain the case was. An equatorial is, to a great extent, useless in the absence of correct local time; and it seems to me that a large number of the possessors of the cheaper forms of telescope now so common, who would shrink from the cost of a regular astronomical clock, would gladly avail themselves of one at the price which I suggest, and for which, I have no reason to doubt, a fairly trust-worthy timekeeper might be produced.

And in the second place. As a clock is itself largely dependent in its usefulness upon the possession by its owner of some independent method of obtaining the real time, I would ask why we should not have a five

pound transit too? Here again elaborate contrivance and high mechanical finish would be wholly out of place; and an instrument which would be capable of indicating the meridian passage of a celestial body within a second of the truth, would be invaluable to a very considerable proportion of incipient amateur astronomers.

Thirdly. It seems to me that for the same sum a clock might very easily be devised and constructed to chime any equatorial up to three or four inches of aperture. This, however, comes somewhat within the category of luxuries, although it is one which no one who has once experienced the ease and comfort of regarding an apparently immovable star or planet in a fixed sky, would willingly forego.

Then, fourthly. The capability of procuring an efficient rotating dome for five pounds would enable many an owner of a moderately sized telescope, to convert an existing summer-house or analogous out-door building into an efficient observatory. Can nothing be done with woodwork and canvas in this direction?

So much for my suggestions to three separate classes of artists as to a mode in which they might legitimately meet the desire of the incipient astronomer to spend twenty pounds. My next shall take the form of a query. It is this: Is the Reverend Professor Pritchard ever going to favour the mathematico-mechanical world with his tables for the calculations of the curves for achromatic object-glasses? We have been promised these tables for—I am afraid to say how long. "The cry is still, they come!"—only they do not.

Lastly. I see by this month's *Astronomical Register*, that a discussion took place at the May Meeting of the Royal Astronomical Society on the subject of the tables of Uranus, and those of the phenomena of Jupiter's Satellites, published in the *Nautical Almanac*, in the course of which it was quietly admitted that the ephemerides of that planet and of those moons were computed from tables formed in 1821 and 1836 respectively, and which are confessedly grossly inaccurate. Now, I should really like to know whether the duties of the superintendent of the *Nautical Almanac* are confined to seeing that the subordinate computers, merely do not take out the wrong logarithms, and to using data which he knows perfectly are absolutely untrustworthy, or whether they might not also be held to include an obligation to provide proper materials for the actual calculators under him to work with? It is pretty obvious that Greenwich Observatory repudiates all responsibility in this matter; and so we go on, year after year hanging out, so to speak, false lights and signals. I will never believe that the Admiralty would decline to grant the necessary pecuniary assistance to perfect a work of such national (in fact, almost mundane) importance as the *Nautical Almanac*, and can only come to the conclusion that it is pleasanter for the executive *stare super vias antiquas*, and to go on in the old jog-trot way, than to take the amount of trouble needful to remove such a discreditable blot from a book, which it ought to be their pride, no less than their duty, to make perfect.

I am, Sir, obediently yours,

June 15, 1871. EGENS.

Astronomy Simplified for General Reading; with numerous New Explanations and Discoveries in Spectrum Analysis. By J. A. S. Rollwyn.

If a pretty external covering, pretty illustrations in glowing colours, with a striking passage here and there, can simplify such a science as astronomy, we have all the elements of simplification in the work before us. Our knowledge of the science, however, leads us to expect that for

attaining this object, which we apprehend is by no means a desideratum, method in exhibiting facts, and clearness in explaining theories, with illustrations which give as closely as may be the appearances of the objects represented, are essential to enable a reader unacquainted with the leading features of astronomy to perceive them as he peruses page after page, and to grasp their relations as he digests the mental food served up to him.

The illustrations, with very few exceptions, are scarcely calculated to convey correct impressions of the objects intended; inasmuch as the delicate softness of the nebulæ, for example, can only with great difficulty be reproduced in an engraving, and the dark ground ought certainly to be the colour of the sky. Green, brown, blue, as that of the sky when the sun shines strongly, are not suitable for such objects as nebulæ, nevertheless they make a pretty book, and many people like pretty pictures.

We should be glad if the illustrations were the only portions of the book on which there was the least possibility for animadversion. We do not remember to have noticed any work in which the subject of "Solar Combustion" has been seriously treated. Is the idea new? or is there any foundation for it? "The sun," says the author, "exhibits every characteristic and evidence of a body enveloped in an atmosphere of flame, the lower part of his atmosphere being comparatively dark, coinciding with that portion of the flame of an ordinary candle or other body under combustion, intervening between the brightest portion of the flame and the wick. Then comes the brightest portion of the flame, or region of white light, called the photosphere; and above that a region in which coloured flame or light is sometimes manifested * * * which last region is called the chromosphere." If the sun be the candle of the Solar system, what becomes of the products of combustion? Mr. Rollwyn supposes the solar surface to be devoid of water—we certainly have no evidence that water exists on the sun—and he further supposes that the small proportion of hydrogen which the sun possesses, floats in the chromosphere above the region of white light and intense conflagration. Smoke being heavier than hydrogen will not, according to our author, "rise higher than the prominences, but descend through the photosphere to the level of its own weight, whereby darkening the lower stratum of the sun's atmosphere; and it is difficult," our author remarks, "to say whether the rents in the photosphere do reveal to us the nucleus of the sun, or merely a dense under stratum of smoke interposed between the nucleus and the photosphere." Perhaps our readers will be inclined to regard Mr. Rollwyn's sun as a smoke-consuming furnace; his remark on the basis of his view is important. "They are not based," he says, "on the still questioned authority of astronomically applied spectrum analysis, but rather on well-established terrestrial chemical analogy, which the solar spectrum in one particular remarkably confirms, that of the composition of the sun's chromosphere." Yet in the previous sentence we find him saying, "so completely do new chemical conditions alter the whole aspect of things, and involve totally different consequences." This is simplifying astronomy.

Our space will not allow us to notice all the extraordinary statements we find in this work. We may, however, remark that the author inclines to the certainty of the existence of the hypothetical planet Vulcan and of the satellite of Venus, in opposition to his own statement that, "Science can never be said in itself to sanction that which it has not absolutely ascertained." We know that much doubt hangs over both these subjects; indeed, it is questionable if in either case the *same body*—the supposed

planet or the supposed satellite—was observed, otherwise we might expect that consistent orbits would have been computed. The author denies the cosmical origin of meteors and meteor streams, referring the *locus* of production to the terrestrial atmosphere; he means terrestrial chemistry. "This," he says, "is definite and appreciable ground on which science cannot err, but may safely stand upright on the basis of demonstration."

The endeavour to simplify science by controverting theories which enable us to feel our way through such intricacies as have beset our path in the interplanetary spaces, where we have become acquainted with the existence of a large number of small planets, and with the connection of cometic orbits and meteor streams is, in our opinion, abortive. It is true the author substitutes something else; but the conflict which arises from opposite statements tends to confuse rather than simplify; and such is the general nature of the author's views that we do not consider he has produced a work which answers to its title—"Astronomy Simplified."

OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS TO MAY 31.

The Sun.—Mr. T. W. Backhouse, of Sunderland, writes that "On March 20th, at 21h. 30m., a spot in the sun's south hemisphere had an umbra 19,000 miles long, but its greatest width was but 3,500 miles. The spot passed the centre of the sun on the 21st. On the 22nd, at 3h., there was a curious curve of numerous small spots starting from it. An extensive group which passed W. of the sun's centre on the 23rd, contained on the 27th, at 5h., the largest spot then on the sun. Its penumbra was 29,000 miles in diameter, and its umbra 14,000 miles long; yet, if it existed at all on the 24th, at 21h., it must have been quite small. A spot in the sun's southern hemisphere, which passed the middle of the sun on April 11, and which was not large on the 6th, on the 7th, at 21h. 35m., had a penumbra 63,000 miles long. On the 9th, at 21h. 15m., it was about 41,000 miles long, and its chief umbra 13,000 miles in diameter, and mostly of a light shade. On April 20, at 21h. 45m., a spot, also in the south zone, had an umbra 25,000 miles long, but its *f* part was very narrow; its *p* part was very irregular. Its *f* part became broader, and on the 24th, at 20h., was separated from the *p* part. The umbra had previously shortened, being only about 21,000 miles long on the 23rd, at 21h. On the 23rd it passed the sun's centre. On the 28th, at 3h. 20m., the penumbra was 38,000 miles long. At that time there was another large solar spot, also in the south zone, which had a penumbra 33,000 miles in diameter then; but on May 4, at 5h. 15m., it was 43,000 miles long and 35,000 miles wide, and it is now (May 8) larger still. Its umbra was roundish and much mottled; and on May 4, at 4h., was 17,000 miles long and 14,500 wide. On the 5th, at 21h., however, there was a very slender bridge of light across it towards the south part, and another north, two-thirds across it. The latter still remained on May 8, 3h. 30m., and nearly cut the umbra in two; but the former had disappeared." Mr. Albert P. Holden, of London, reports as follows:—"April 10, 1871. A large spot surrounded by an extensive penumbra has recently appeared, which I observed at 2h. this day. The chief spot was rather long and narrow, except at one end, which was considerably wider, and the narrow portion was crossed by three complete (and one partial) bridges. The penumbra was unusually pale, and the umbra of a decidedly light brown hue. In the upper part of the broad portion of the umbra

was a large nucleus intensely black, and so large and dark as to be visible with a very low power. Almost joining the 'yawning gulf' of the nucleus was a light, triangular patch, not quite so light as the penumbra. From the great ease with which the nuclei have been seen on this and other occasions, it would seem as if they increased in visibility with the approach of the maxima of sun-spot period. When they are visible, as on the present occasion, the umbra and penumbra of the spot in which they occur are always unusually high in colour." Mr. William F. Denning, of Bristol, observed the sun with his 10¼-in. and 4-in. reflectors on May 26; but, with the exception of a large scattered group, the spots were neither large nor interesting.

Jupiter.—Mr. Albert P. Holden says:—"On February 20, at 7h. 30m., I observed the planet, and found the usual equatorial belts to present a most remarkable appearance. The whole equator was covered by what appeared to be great masses of clouds stretching across the planet in four parallel but rather irregular rows, each row containing about four or five distinct masses of cloud. As I was using a diagonal eyepiece, I thought at first the mirror had become covered with moisture, but found the phenomenon to really be on the planet's surface. With a low power the whole equator had a mottled appearance, but higher powers brought out the mass of cloud very distinctly. Clouds coming over prevented my observing whether or not the rotation of the planet would change the scenery of the disc at all." Mr. Edmund Neison, of London, writes, with regard to this planet:—"The only result worth mentioning is the gradual deepening of the tinge of the equatorial belt, and the increase in the general orange tinge of the whole disc. In fact, on May 15 it appeared to have changed to a distinct red. This is probably due merely to the low altitude of the planet and its immersion in the orange mists of sub-sunset."

Mars.—Mr. Albert P. Holden, with his 3-in. refractor, has obtained some very good views of this planet. He writes:—"The Kaiser Sea and Dawes Ocean come out very distinctly. This planet seems to bear magnifying much more readily than other objects; 80 to the inch of aperture giving most excellent views."

RECENT OCCULTATIONS OF URANUS.—On page 131 of the *Register* for June, there is an enquiry as to when the last Occultation of Uranus took place. On searching, I cannot find mention made of any since 25th August, 1839, when the planet disappeared at 8h. 45m. and reappeared at 9h. 17m. It would be interesting to know how far the tables were in error thirty-two years back. Can any of your readers give information on this point? At the Occultation of February last the sky was here cloudy. On the morning of March 3 it was bright, but I missed the disappearance of the planet for the same reason as others.

Upton Helions Rectory, Devon. S. J. JOHNSON.

THE PLANET AMALTHEA.—The following elements of the new Planet Amalthea (113) have been published by M. Oppolzer, of Vienna:—

Epoch: 1871. March 13.		°	′
Mean Longitude	=	178	51
Mean Anomaly	=	339	36
Longitude of Perihelion ...	=	199	15
Longitude of Ascending Node	=	123	4
Inclination	=	5	2
Angle of Eccentricity ...	=	4	55
Mean Daily Motion ...	=		968″
Log. Mean Distance ...	=	0·375,895	

OBSERVATIONS FOR JULY, 1871.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, midnight		60°N.		0°		60°S.
			SUNRISE.			
		°		°		°
1871. July 1	...	−81·6	...	−81·1	...	−80·7
			SUNSET.			
2	...	+87·2	...	+86·7	...	+86 2
3	...	75·0	...	74·5	...	74·0
4	...	62·9	...	62·3	...	61·7
5	...	50 7	...	50·1	...	49·5
6	...	38·6	...	37·9	...	37·2
7	...	26·4	...	25·7	...	25·0
8	...	14·2	...	13·5	...	12·7
9	...	+2·1	...	+1·3	...	+0·5
10	...	−10·1	...	11·0	...	−11·3
11	...	22·3	...	23·2	...	24·1
12	...	34·5	...	35·5	...	36·4
13	...	46·7	...	47·7	...	48·7
14	...	58·9	...	59·9	...	60·9
15	...	71·1	...	72·2	...	73·2
16	...	−83·3	...	−84·4	...	−85·5
			SUNRISE.			
18	...	+69·9	...	+71·1	...	+72·2
19	...	57·6	...	58·8	...	60·0
20	...	45·3	...	46·6	...	47·8
21	...	33·0	...	34·3	...	35·6
22	...	20·7	...	22·1	...	23·4
23	...	+8·5	...	+9·9	...	+11·2
24	...	−3·8	...	−2·4	...	−1·0
25	...	16·1	...	14·6	...	13·1
26	...	28·3	...	26·8	...	25·3
27	...	40·5	...	39·0	...	37·5
28	...	52 8	...	51·2	...	49·6
29	...	65·0	...	63·4	...	61·8
30	...	−77·2	...	−75·6	...	−73·9

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JULY, 1871.

By W. R. Birt, F.R.A.S.

Day.		Supplement ☾ — ☉ Midnight. ° ′		Objects to be observed.
20	...	142 24·8	...	Mare Crisium, E border, with the two promontories at the "Pass."
21	...	130 28·3	...	Guttemberg (*a*), Navigators' Nook (*b*).
22	.	118 17·3	...	Central Mountain of Theophilus (*c*).
23	...	105 50·9	...	Sabine, Ritter, Gwilt Brothers (*d*).

24 ...	93 8·4	...	Archytas, craters between it and Egede.
25 ...	80 9·5	...	Craters and mountains between Archimedes and Plato (*e*).
26 ...	66 54·6	...	The Alps and wedge-shaped valley (*f*).
27 ...	53 25·2	...	Ramsden, remarkable valley and clefts in its neighbourhood.
28 ...	39 44·4	...	Horrebow, its interior wall Harpalus.
29 ...	25 56·9	...	Scheiner, Blancauus, Gruemberger.
30 ...	12 8·6	...	Wargentin, Schiller.
31 ...	—1 32·7	...	Crüger, Byrgius, Rosse (*g*).

For additional objects consult the lists for March and May.

(*a*) This formation is not open on the south, as shown in our maps. It has a nearly filled ring on its N.W. border (see *English Mechanic*, No. 323, June 2, 1871, p. 261).
(*b*) A region west of the Pyrenees, containing craters named after celebrated navigators, Magelhaens and others (see *Monthly Notices, R. A. S.*, vol. xxiv., p. 20).
(*c*) Determine succession and direction of peaks as they come into sunlight.
(*d*) Named to commemorate the architectural labours of the Gwilts.
(*e*) On May 26, Piazzi Smyth and Rumker were not in sunlight; look for them on July 25.
(*f*) Examine the interior for craterlets.
(*g*) See *Monthly Notices, R. A. S.*, vol. xxiv., p. 20.

Errata in No. 102, p. 147, line 12 from bottom, for *calculation* read *calculator;* line 16 from bottom, for *Olbeis* read *Olbers.* Page 149, line 2 of (*i*), for *Gandibert* read *Gaudibert.*

THE PLANETS FOR JULY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	5 57 31	+23 37½	5″·4	23 17·3
	15th	7 58 33	22 26	5″·0	0 26·9
Venus ...	1st	9 47 11	+14 56½	19″·9	3 10·3
	15th	10 40 1	8 57	23″·0	3 7·9
Mars ...	1st	12 25 16	—2 42	9″·1	5 47·9
	15th	12 51 2	5 44	8″·5	5 18·6
Saturn ...	1st	18 27 3	—22 33½	16″·6	11 49·2
	15th	18 23 12	22 36½	16″·6	10 49·8

Mercury is a morning star till the middle of the month : he sets a short time after sunset after the 8th.

Venus is still excellently situated for observation of an evening. Her illuminated portion gradually decreases throughout the month.

Mars is still an evening star, setting earlier each day ; at the end of the month setting about two hours and a quarter after sunset.

Saturn is visible all the night.

ASTRONOMICAL OCCURRENCES FOR JULY, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn
Sat	1	 19 23	Sidereal Time at Mean Noon, 6h. 36m. 23·54s. Conjunction of Moon and Saturn, 1° 16′ N. Saturn's Ring: Major Axis=41·52″ Minor Axis=18·12″			— 11 49·3
Sun	2	1 36 13 23 14 34	○ Full Moon Occultation of χ′ Sagittarii (6) Reappearance of ditto			11 44·9
Mon	3		Sun's Meridian Passage, 3m. 49·15s. after Mean Noon			11 40·7
Tues	4	17 0	Near approach of ε Capricorni (4½)			11 36·5
Wed	5					11 32·2
Thur	6	19 12 21 21	Conjunction of Venus and *a* Leonis (7·8m.) W. Conjunction of Jupiter and Mercury, 0·59′ N.			11 28·0
Fri	7					11 23·7
Sat	8	11 52	Occultation reappearance of 20 Ceti (5½)			11 19·5
Sun	9	1 9	☾ Moon's Last Quarter			11 15·3
Mon	10	23 46	Superior Conjunction of Mercury			11 11·0
Tues	11					11 6·8
Wed	12	20 23	Conjunction of Venus and ρ Leonis (5·9m.) W.			11 2·5
Thur	13					10 58·3
Fri	14	14 47	Conjunction of Uranus and Mercury, 1° 14′ N.			10 54·0
Sat	15		Illuminated portion of disc of Venus=0·507 " of Mars=0·878			10 49·8
Sun	16	4 5	Conjunction of Moon and Jupiter, 1° 0′ S.			10 45·6

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn —
Mon	17	 5 27 9 1 21 45	Sidereal Time at Mean Noon, 7h. 39m. 28·45s. ● New Moon Conjunction of Moon and Uranus, 1° 48′ S. Conjunction of Moon and Mercury, 1° 1′ S.			10 41·4
Tues	18		Sun's Meridian Passage, 5m. 48·32s. after Mean Noon			10 37·2
Wed	19	15 4 22 14	Conjunction of Uranus Conjunction of Venus and *c* Leonis, (2·4m.) W.			10 32·9
Thur	20	23 51	Conjunction of Moon and Venus, 5° 27′ S.			10 28·7
Fri	21					10 24·5
Sat	22					Moon. — 5 7·9
Sun	23	14 45	Conjunction of Moon and Mars, 5° 51′ S.			6 1·9
Mon	24	17 51	☽ Moon's First Quarter			6 59·3
Tues	25					7 59·6
Wed	26					9 1·2
Thur	27	1 4	Conjunction of Venus and *τ* Leonis (2·0m.), E.			10 1·9
Fri	28			1st Tr. I.	14 47	10 59·9
Sat	29	2 20 8 24	Conjunction of Moon and Saturn, 1° 4′ N. Near approach of B.A.C. 6369 (6)	1st Oc. R.	14 27	11 54·3
Sun	30					Saturn 9 46·8
Mon	31	9 16 16 2	○ Full Moon Near approach of χ Capricorni (6)			9 42·7
AUGUST. Tues	1	18 37	Conjunction of Mars and *h* Virginis (1·0m.) E.	2nd Sh. I.	16 17	9 38·5

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1871.

Ormersher, H.

To Sept., 1871.

Blacklock, A. W.
Cook, James.
Glover, E.
Ingram, Rev. H.
Metcalf, Rev. W. R.
Wright, W. H.

To Dec. 1871.

Herschel, Capt. J.
Hibbert, G.
Jefferies, J.
Johnson, Rev. S. J.
Squire, H.
Shawcross, W.
Stothard, Dr.

To March, 1872.

Herschel, Prof. A. S.

June 24, 1871. Subscriptions after this date in our next.

Instruments, &c., For Sale or Wanted.

These Notices, which must in all cases be paid for in advance, are inserted at the rate of *One Shilling* for *Twenty Words* or under; half-price only will be charged upon repetition, if no alteration is required. When the address is not given, application may be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—The Notice will be withdrawn should the payment not be renewed.

TO CORRESPONDENTS.

THE INDEX AND TITLE to the last Volume of the *Register* is, we regret to say, not yet ready, but we hope will soon be completed; due notice will be given to Subscribers.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 104. AUGUST. 1871.

ANCIENT ECLIPSES.

In previous Numbers of the *Register* mention has been made of ancient eclipses: No. 51, page 71; No. 63, page 70; No. 100, page 98. It might gratify some readers to mention a few more. In Ingram's translation of the "Saxon Chronicle" (Longmans, 1823), several old eclipses are spoken of. I have here selected what seem to be some of the more interesting of them. The results of the computations I have made about them are given below, as I have never seen mention made of any of them except the last.

A.D. 733. "This year Ethelbald took Somerton? the Sun was eclipsed, and Acca was driven from his bishopric." The eclipse must have been on August 14, when I find a very large one took place, but not total, the Moon's semidiameter being 15′ 22,″ the Sun's 15′ 54.″ It seems to have been annular at London at ¼ past 7 that morning.

A.D. 827. "This year was the Moon eclipsed on midwinter's mass night." The eclipse of December 25, 828, must be here meant. It began a few minutes after the previous midnight, was total for 1¼h., and ended a few minutes before 4.

A.D. 1110. "The king held his court this year for the first time in New Windsor. On the 5th night in the month of May appeared the Moon shining bright in the evening, and afterward by little and little its light diminished, so that as soon as night came on it was so completely extinguished withal, that neither light, nor orb, nor anything of it was seen. And so it continued nearly until day, and then appeared shining full and bright. It was this day a fortnight old. All the night was the firmament very clear, and the stars over all the heavens shining very bright, and the fruits of the trees were this night sorely nipt by the frost." I find a total eclipse of the Moon began this evening about 9h. 10m.,

and ended 12h. 40m. Totality lasted over 1h. 35m. From the description, "Neither light, nor orb, etc., was seen," this must surely have been one of those rare cases such as in 1642, 1761, when the Moon's disc disappeared entirely during totality, instead of appearing of the ordinary copper tint.

A.D. 1117. "In the night of the third day before the Ides of December was the Moon during a long time of the night as if covered with blood." On the night of December 9, this year, an eclipse of the Moon began about 10h. 22m., became total 11h. 22m., continued so till about 1 a.m., and ended at 2h.

A.D. 1135. "In this year went the King Henry over sea at Lammas: and the next day as he lay asleep on ship, the day darkened over all lands: and the Sun was all as it were a three-night-old Moon, and the stars about him at midday. Men said a great event would come, and the same year was the king dead, the day after S. Andrew's mass-day, in Normandy." There must be a mistake here. At the new Moon in August of this year there was no eclipse, the Moon being too far from the node. But on August 2 (the day after Lammas), 1133, an eclipse took place, which seems to answer the conditions pretty well. It amounted to more than ten digits of the Sun's disc, at London, at 11h. 5m. that morning. Thus the Sun would assume the appearance of a three-night-old Moon. Further south the eclipse would be total, and the description of the stars showing themselves must be taken from those who saw it there.

A.D. 1140. "In the Lent the Sun and the day darkened about the noontide of the day, when men were eating, and they lighted candles to eat by. That was the 13th day before the Kalends of April. Men were very much struck with wonder." Another old chronicle says this happened at the 9th hour of the day. I find a total eclipse of the Sun actually did take place on March 20, the totality being attained about 2h. 37m.

These computations were made from the Tables in the Encyclopædia Britannica, eighth edition.

S. J. JOHNSON.

Upton Helions Rectory, Devon.

The death is announced of Dr. FRANZ VON SCHAUB, the astronomical computer of Vienna.

A NEW COMET has been discovered by M. Schiaparelli. Right ascension, July 30, 4h. 49·2m.; declination, $+59° 25'$; motion retrograde. It is an object of extreme faintness.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MR. NEWALL'S TELESCOPE.

Sir,—As some sort of answer to Mr. Newall, I forward a list of the number of clear nights since 1858, taken from my note-book. By clear nights I mean nights clear throughout till, say, 11 p.m., or else clear for an hour or two. Formerly, I was in South Lancashire, about 12 miles from Manchester (not one of the most smoky parts); since the early part of 1870 I have been in Devonshire. The comparative number of clear nights is immensely in favour of the latter locality, though doubtless some allowance should be made for the extraordinary and long continued fine weather of last year.

In 1859,	number of nights clear throughout or in part	... 60
„ 1860	„ „ „	... 43
„ 1861	„ „ „	... 46
„ 1862	„ „ „	... 46
„ 1863	„ „ „	... 47
„ 1864	„ „ „	... 83
„ 1865	„ „ „	... 82
„ 1866	„ „ „	... 77
„ 1867	„ „ „	... 55
„ 1868	„ „ „	... 62
„ 1869	„ „ „	... 58
„ 1870	„ „ „	... 112
„ 1871	„ „ (first half till June 30)...	43

Upton Helions Rectory,
Crediton, Devon.

Yours faithfully,
S. J. JOHNSON.

DESIDERATA.

Sir,—In reply to the excellent suggestive communication, under the above title, by "Egens," in this month's *Astronomical Register*, I have the pleasure to inform him that a good, sound Siderial Clock *can* be produced for £5; the pendulum beating seconds and the clock striking the seconds. The face is divided all round the twenty-four hours, and furnished with a seconds hand. The case is of pine, neatly grained and varnished. The escapement is that known as chronometer, and the pendulum, which is only ten inches in length, has its compensation effected by a tubing of zinc working on steel.

The followiug are the dimensions of the clock :—

Height of case	20 inches.
Breadth of ditto	11 „
Depth	6 „
Diameter of disc	8 „

The above clock is a first-rate timekeeper.

Mr. Cocks, of Wells-next-the Sea, tells me he will be happy to receive the names of gentlemen requiring such clocks; and as soon as he gets a list of twenty, he will immediately put the work in hand, and deliver the clocks (*for cash*) to the subscribers, according to priority, the whole number being completed in a very few months. On receipt of twelve postage stamps, a photograph of the clock will be forwarded by Mr. Cocks to any address.

The clock may be timed most readily by Dent's Dipleidoscope, which, if correctly adjusted for the meridian, will give the time *within* a second; indeed, sufficiently accurate for most amateur purposes. This elegant little instrument costs £2 12s. 6d.

I am, Sir, yours obediently,

HABENS.

THE TABLES OF URANUS.

Sir,—In reply to Mr. Johnson, Loomis ("Treatise on Astronomy," p. 243) states that the difference between the observed place of Uranus, and that computed by Bouvard's tables (the same as now used) in 1840, was —82″, and in 1846, —128″. Grant ("History of Physical Astronomy," p. 167) states the discordance in 1838 amounted to 50″; in 1841, to 70″. Perhaps if Mr. Lynn's letter in the *Astronomical Register* three years ago (June 6, 1868, vol. 6, p. 159), had been remembered, observers would have allowed more for the errors of his tables, and not have missed the last occultation. Egens, however, is wide of the mark in his remarks on this subject. The preface to the *Nautical Almanac* gives the names of the authors of the tables used in its computations, and all that the computers can be expected to do is to take the best existing. The *improbus labor* of making new tables falls as little to their province, as it does to that of the Greenwich Observatory, the data furnished from which to Hansen enabled that eminent mathematician to bring the lunar tables to their present almost unhoped for perfection; for Euler despaired of the possibility of ever computing the moon's place nearer than 30″. Doubtless there are also many observations of Uranus available for any one possessed of sufficient ability and leisure to use them for making new tables. For much in our *Nautical Almanac* we are indebted to Leverrier, Hansen, Peters, Bouvard, Damoiseau, and Newcomb; one would wish to see more English names in this high department than those of airy, Adams, Baily, and Woolhouse, distinguished as those are. It is to be hoped that with the large number of persons who now cultivate astronomy more or less, there may be also a few whose tastes and acquirements may lead them to furnish by-and-by illustrations of Schumacher's remark (*Astronomical Register*, for June, p. 147) about the value to the science of a single exact and able calculator. We appear to want something to encourage and lead students in this direction. We have good works on descriptive and practical astronomy; but some work is needed in the way of introduction to the physical department; the calculation of planetary and cometary orbits, perturbations, and the construction of tables; of the toil and intricacy of which the non-mathematical reader may form an idea by the study of Airy's *Treatise on Gravitation*. Meanwhile, if defects in the tables of Uranus, and of Jupiter's moons (I have always found the eclipses of the first and second accurately given, and have avoided having much to say to the third and fourth), constitute, as Egens says, "a discreditable blot" on the *Nautical Almanac*, it is one, as far as I know, from which no astronomical ephemeris in existence is free.

For myself, I am more thankful for things as they are, than disposed to find fault because they are (through nobody's fault) not better. If Delambre had not been followed by Bouvard in this instance, we should have had to put up with still greater errors; and as it is, we must only hope that they are approaching their maximum, and wait for a worthy successor to the latter.

Whether the Admiralty, as suggested by Egens, would attach importance to a question of some astronomical, but no navigational value, is, I fear, doubtful. I should place more confidence in the result of a prize offered by some learned body for a revised theory of the planet; such as that proposed by the Academy of Sciences of Paris, and which led to the theory and tables of Delambre.

I never pay my half-a-crown for a new *Nautical Almanac* without feeling grateful to the skilful opticians and observers who made such a publication possible; to the talented and indefatigable investigators who used so much brain-work and perseverance in obtaining formulæ, unravelling perturbations, and eliciting symmetry from the observations; to the computers who so patiently and accurately worked up the materials thus placed at their disposal; and to the Admiralty for selling such a book at such a price :—

"*Hic meret æra liber Sosiis; hic et mare transit.*"

And Egens, I am sure, appreciates all this too. But he affirms that we go on hanging out "false lights" every year. Yet if I know that the lights in question indicate a shoal of shifting dimensions, or uncertain outline, I ought to make due allowances for it, and direct my course accordingly.

"*Verum ubi plura nitent in carmine, non ego paucis*
Offendar meculis,—"

especially when these maculæ are owing to no carelessness, but merely to the force of circumstances. Clouds here prevented any observation of the last occultation of Uranus. We shall all, no doubt, be more "up to" this unruly planet next time. After what Mr. Dunkin said at the May Meeting of the Royal Astronomical Society, I should certainly, includ ng the possible effect of parallax, not look for the occultation less than iten minutes before the time noted in the *Nautical Almanac;* and probably a quarter of an hour would not be too much for observers whose longitude is greater. The first part of the letter of Egens every one must go along with. We must hope it will attract attention. I have sometimes thought it might serve the interests both of opticians and their customers if instruments could be let out on hire, or paid for by instalmenst, as ladies sometimes get pianos.

The late Professor De Morgan wrote in 1836, "Nobody but a mathematician can sympathise with the director of an observatory, using all his efforts of body and mind, so to improve the lunar theory as to abolish the second of time (or thereabouts), by which she will not come on the meridian according to prediction." And he has a note of a supposed dialogue between two astronomers, not exaggerated, which is as follows :—

A. Have you seen the volume of observations for this year?

B. No, but I am told the moon is very much out.

A. Yes; indeed, almost two seconds in one place.

B. The small planets alogether wrong, as usual, I suppose?

A. Yes, Pallas is out nineteen seconds! However, some of that is in the epoch.

B. I wonder whether we shall ever know anything at all about those small planets, etc.?

"This" continues the professor, "will serve the reader to adjust his notions, when he hears, in one point of view that modern astronomy is very correct, and in another that it is all wrong. The first looks to what has been obtained, the second to what remains to be done."

The tone of quiet resignation, and patient, though but faint hope of a "better time coming," in this, rather amusingly contrasts with the somewhat excited discussion lately on the subject of Uranus. One can sympathise with the gentlemen who missed the occultation, whilst puzzled rather to conceive how any one acquainted as an F. R. A. S. might be expected to be, with the whole history of the perturbations of Uranus, leading to the astonishing discovery of Neptune, could place himself, as Captain Noble says he did, at the telescope, only two minutes before the predicted time! After so singular an amoumt of disappointed faith in this part of what has been termed the "Astronomer's Bible," the Captain seems to have rebounded into an equal degree of scepticism, and thinks the Government ought at least to give warning "their book is not to be relied upon!" This probably, on reflection, the respected Signor Capitano himself would consider somewhat too broad; and he would perhaps be content if a general allusion to the defects in the existing tables of Uranus were inserted, as has been already done in the case of Jupiter's satellites. (*Naut. Almanac*, p. 545.) This, however, could not appear till the *Nautical Almanac* of 1875, till which time may he and all of us, including the local board, and the carpenter, whose education, it appears, has been neglected, be spared. Who knows, but that before then we may see a better "direction-post" put up, and this shockingly misbehaved planet considerably reformed?

I am, Sir, yours, etc.,
GEORGE J. WALKER.

INDIAN ASTRONOMY.

The celebrated Aryabhata was born A.D. 476. Lassen calls him "the founder of mathematical and astronomical science in India;" meaning, no doubt, that he gathered up the scattered learning of preceding centuries, and infused into it the more correct views which his master-mind had received from Greek teaching. His idea of the roundness of the earth is thus expressed:—"The terrestrial globe, a compound of earth, water, fire, and air, entirely round, encompassed by a girdle (*the equator*), stands in the air, in the centre of the stellar sphere. Like as a ball formed by the blossoms of the nauclea Radamba is on every side beset with flowerets; so is the earth-globe with all creatures, terrestrial and aquatic." And this globe he believed to have a daily revolution. "Aryabhata," says Dr. Keon, "for aught we know, was the first, and remained almost the sole astronomer among his countrymen, who affirmed the daily revolution of the earth on its own axis." He gives the following quotation from one of Aryabhata's works:—"As a person in a vessel, while moving forwards, sees an immovable object moving backwards; in the same manner do the stars, however immovable, seem to move daily." On another occasion Aryabhata says: "The sphere of the stars is stationary; and the earth, making a revolution, produces the daily rising and setting of stars and planets." Mr. Colebrooke states that "Aryabhata affirmed the diurnal revolution of the earth on its axis;" that he accounted for it "by a wind or current of aerial fluid, the extent of which, according to the orbit assigned to it by him, corresponds to an

elevation of little more than a hundred miles from the surface of the earth; that he possessed the true theory of the causes of lunar and solar eclipses, and disregarded the imaginary dark planets of the mythologists and astrologers, affirming the moon and primary planets (and even the stars) to be essentially dark, and only illuminated by the sun."

But after attaining this excellence, Astronomy in India appears to have drifted away from science, and writers subsequent to Aryabhata confuse astronomy with astrology.

Varâhamihèra may be cited as a celebrated astronomer, to whom astrology was irresistibly attractive (born A.D. 530).

Dr. Kern observes, that he was in "the awkward position of a man who has to reconcile the exigences of science with the decrees, deemed infallible, of the Rishis" (inspired poets of the Rigveda). Varâhamihèra is noted for using Greek terms, and for his frequent reference to Yavanas (Greeks). "Astrological prediction," observes Mr. Colebrooke, "by configuration of planets, indicates by its Indian name, Hora, a Grecian source. Of this word, Varâhamihèra has attempted a Sanskrit derivation, which is not conformable to Sanskrit etymology; whereas the Greek *hora*, and its derivative *horoscopos*, means one who considers the natal *hour*, and thence predicts events." Colebrooke gives further evidence to the same effect, and says that Varâhamihèra frequently quotes the *Yavanas* in his treatise on horoscopes, and his scholiast characterises ancient Yavanas as a race of barbarians conversant with (*hora*) horoscopes." The English translation of Varâhamihèra's System of Natural Astrology commences thus:—"Victory to the all-soul, the source of life, the inseparable ornament of heaven—the Sun, who is adorned with a crown of a thousand beams, like unto liquid gold."

Mr. S. Wilkinson for eight years had tried in vain to convince his friend, Subhaji Bâpû, of the sun's relation to the earth. Then, happening to meet with the old Hindu works, he was able to teach the same from his own acknowledged authorities, and at once conviction was carried to his mind.

Mr. Wilkinson describes Subhaji Bâpû as a man of wonderful acuteness, intelligence, and sound judgment, who was lost in admiration when he came fully to comprehend all the facts resulting from the spherical form of the earth. And when the retrogressions of the planets were shown to be so naturally accounted for on the theory of the earth's annual motion; and when he reflected on the vastly superior simplicity and credibility of the supposition that the earth had a diurnal motion, than that the sun and all the stars daily revolve about the earth, he became a zealous defender of the system of Copernicus. He then lamented that his life had been spent in maintaining foolish fancies, and spoke with bitter indignation against all those of his predecessors who had contributed to the wilful concealment of the truth that error had been acknowledged in the land.—[Related at a meeting of the Associate Society of Bengal, June 7, 1837. Letter from Mr. Wilkinson to Sir W. H. Macnaughten.]

Subhaji Bâpû has since become a distinguished astronomer and professor at the Government College of Benares.—*Ancient and Mediæval India.* By the late Mrs. Manning. Vol. I. pp. 359—378 (1869).

INSTRUMENTS FOR SALE.—One or two scarcely pardonable blunders have occurred lately in our notices of instruments for sale. These having been corrected, and the notice repeated, we need not further allude to them, except to remark that a 6-inch telescope offered for

twenty pounds caused us to have to reply to a great number of letters on the subject, from those anxious to obtain a large instrument at so low a price : the error to some extent thus brought its own punishment. We may add with regard to these notices, that many have remarked that our list of instruments for sale is neither so long nor so interesting as it used to be, and have urged us to revert to the plan of inserting them gratis. We can only say that when we did so, many remained in the list long after the instruments referred to were sold, from want of information supplied to us ; and therefore the list appeared longer than it should have done. We may also say that for some time there do not appear to have been so many second-hand instruments for disposal as formerly: in fact, applications are now almost as numerous for purchase as for sale. There is no doubt that really good telescopes find a ready sale in private, and that even instruments not of the very first class can be sold if the price asked is moderate.

HACKNEY SCIENTIFIC ASSOCIATION.—The Fourth Annual Meeting of this Society was held on June 6, when there was a good attendance of members. From the report read by the honorary secretary, Mr. H. W. Emons, it appeared that the Society had made good progress during the past session, the number of members having more than doubled, and the papers communicated having been unusually numerous and interesting. The more immediate contributions by the members to the progress of astronomy comprised :—"A Method for Ascertaining the Existence of Lunar Changes," by Mr. W. R. Birt, F.R.A.S., Vice-President ; "The Discovery of a New Variable Star, ε Hercules," by Mr. H. T. Vivian ; "A Determination of the Dimensions of the System of Algol," by Mr. A. P. Holden ; and the preparation of "A New Classified Catalogue of Variable Stars, for the use of Members." In addition to the introductory address, by Mr. W. T. Lynn, B.A., F.R.A.S , on "Recent Progress in Astronomy," papers have been read on "Comets ;" "Evidences of Recent Changes on the Moon's Surface ;" "The Physical Constitution of Variable Stars ;" "Observations on Solar Eclipses ;" and many others. Good progress had also been made with the library, which had been enriched by contributions from G. J. Walker, Esq., and other gentlemen ; also from members and several societies, to all of whom the thanks of the meeting were awarded. The officers for the next session having been elected, the meeting adjourned ; thus bringing a very successful session to a close.

ON THE STUDY OF SELENOGRAPHY.

By W. R. BIRT, F.R.A.S.

The successful prosecution of the study of selenography in common with that of every other branch of science is greatly influenced by the earlier steps taken by the student. If the foundation be well laid by obtaining a systematic acquaintance with the broader and larger features of the moon's surface, the after process may be proportionally rapid. The essential requisites are telescopes, maps, and catalogues ; the first for viewing the surface, the second and third for identifying the objects seen. For *beginning* an inquiry into the aspect of the moon's surface, we should strongly recommend the employment of a *small* telescope of not more than three or four inches aperture, and for an instrument under three inches we have now before us a map 4¾ inches diameter, with 155 references,

published in the *Leisure Hour*, for July 15, 1871, which is particularly suitable for a beginner.

Having directed his telescope to the moon at an early phase of the lunation, we should advise, in the *first* place, an identification of the so-called seas, maria, or grey plains, proceeding from west to east. To these there are twenty references, and the identification of them may interestingly occupy one lunation. The identification of the mountain ranges is more difficult. We should not recommend a *first* attempt in this direction until just after the moon had passed her first quarter, previous to which it would be desirable for the observer to read the article on "Mountain Scenery," in the *English Mechanic*, No. 322, May 26, 1871, p. 222. At the phase mentioned, the *Alps*, *Caucasus* and *Apennines*, may be readily identified, and a very correct notion of the appearance of lunar mountain ranges obtained. When this is accomplished, the student may proceed to identify the remaining mountain chains specified on the map referred to.

In addition to these mountain chains there are numerous isolated mountains scattered over the surface of the moon, and it is desirable that the student should be able to distinguish easily between a mountain raised above the surface, and a crater or pit sunk below it. For this purpose a study of shadow is indispensable. Shortly after new, the moon's western limb is illuminated, and *all* shadows are thrown towards the east, a mountain has therefore its western slope strongly illuminated by the rays of the rising sun, while its shadow extends on a plain or rugged surface, as the case may be, towards the east. Many of the craters are surrounded by a mountainous ring, which in like manner has its shadow thrown towards the east, generally of a triangular form, ending in a point; in addition, the shadow of the west rim is thrown *within* the crater, and takes a form dependent upon the nature of the interior, if shortly after sunrise it extends nearly as far as the eastern rim, it is convex in shape. Should the crater be shallow, the shadow soon falls upon the floor, and as it recedes from the eastern rim it is concave towards the rim; but if the crater be deep, it retains the convex form during a period proportioned to the depth. The shadows of both mountains and of craters, interior and exterior, are greatly modified by the nature of the surface on which they fall, as well as by the irregularity or smoothness of the outlines of the mountains and rims of craters. If any doubt should arise as to the true nature of an object, an examination of it under the evening light will clear up many a difficulty.

From the identification of the mountain ranges, the observer may proceed to that of the named objects, of which there are 123 specified. As the arrangement of these is, with but few exceptions, from west to east, he will find it convenient to examine them in order from evening to evening until he is fully acquainted with their leading features. It is not at all unlikely that in the course of this examination many interesting details and features that could not be specified or alluded to in a map on so small a scale may so arrest his attention that he may be desirous of possessing some references to them, and he may be disposed to postpone the general identification of objects while he studies some particular region. Now this desire should not be repressed, and in order to carry on both lines of study effectively, he should keep *two* note-books; one especially devoted to *identifications only*, in which the work of each evening, with all the necessary elements for ascertaining at the epoch of observation, the nature of the illumination and visual angle, including the day of the Julian period, should be entered: the other for extra work, as sketching and describing any particular region, the features of which the observer may be much interested with. Although he may think that

while he is interested, the features sketched and described are well known to other observers ; yet in this respect he may be much mistaken, for such is the state of selenography at the present epoch, that many valuable records may be absolutely lost, merely because observers have set too low a value on their observations, and have taken no steps to place them on permanent record. At some future time an observation of an object as seen at a given epoch, and duly recorded, may possess a value which the observer may never have contemplated, by setting at rest a question of change, which could not have been determined without it. In connection with these remarks it would be well if some receptacle for the preservation and consultation of selenographical observations could be established. At present the literature of this branch of science is not extensive, to increase it, especially as regards the printing of observation, would not be remunerative ; to make copies of their observations would be too laborious for observers; but if their note-books, when filled, were deposited in an office for safe custody, where they might be inspected under proper regulations, we have no doubt selenography would rapidly progress.

While using the little map above referred to, the selenographical portion of the Rev. T. W. Webb's "Celestial Objects for Common Telescopes," may be perused with advantage ; in it the reader will find some very interesting general remarks on lunar features, followed by short notices of those that are the more conspicuous. These notices will greatly assist the student, who we have no doubt will find much pleasure in *extending* them, not that we would intimate that the author of this most useful work has given the fullest information in his power, for we know that he could have given a far greater quantity, but the scope and aim of the work is such as to preclude the introduction of any lengthened description of even the most prominent objects. In the valuable series of papers on lunar details by the same author, in the *Intellectual Observer*, the reader will find much useful information ; but even with these there is great room for adding to our knowledge. The closing portion of Mr. Webb's chapter on the moon consists of list of 426 objects, with references to his index map, which has probably been found more useful than any extant. As a new edition of the work is called for, it is the intention of the author to submit the map to a careful revision, in the course of which several objects will be inserted, doubtful portions of the map redrawn, and the nomenclature extended by including additional names.

The previous use of the *Leisure Hour* Map will have prepared the students for entering very efficiently on the examination of the moon with the aid of Mr. Webb's Map ; and we would recommend precisely the same course of study, viz., the identification of objects proceeding from west to east, recording carefully in its appropriate note book each evening's work, and the extra work of examining special objects. In a future article we may probably call attention to the study of more minute detail, for which elaborate helps are needful.

Sulla Vitane Sulle Opere di Giovanni Inghirami, Memorie Storiche, da Giovanni Antonelli delle Scuole Pie, Prof. di Matematiche e di Astronomia, &c., &c. Firenze, 1854.

The family of Ingram, or Inghiram, in Italian, Inghirami, appears by a tradition preserved in it, to have been of Saxon origin, and to have removed to Italy at the time of Otho the Great (d. A.D. 973), and settled at Volterra. Ancient annals make frequent mention of its part in the

factions which often occurred between different municipalities, and several of its members are found to have held high public offices. Giovanni Inghirami, son of the Cavaliere Niccolò Inghirami, was born at Volterra, on the 26th April, 1779. His brother Francesco is well known as the author of several splendid works: the *Monumenti Etruschi*, the *Galleria Omerica*, *L'Etrusco Museo Chiusino*, and *La Storia della Toscana*. He died 17th May, 1846. Giovanni Inghirami entered the order of the Poor Regular Clerks of the Scuole Pie (Pious Schools), or Calasanzian Institute, called after the meritorious Spaniard, Joseph Calasanzio, who founded it towards the close of the sixteenth century, for the gratuitous education, both religious and secular, of the youth of all classes. Inghirami devoted himself passionately to the study of physical mathematics; above all other branches to astronomy and geodesia, in which, under the famed professors, Stanislao Canovai and Gaetano del-Ricco, he soon attained to high proficiency. Become in his turn a teacher, the reputation obtained by his success in this line was increased by the academic essays which he produced at the close of the scholastic years. Besides others relating to pure mathematics and astronomy, may be mentioned those on the *Principles of Hydromechanics*, and on the *Statics of Buildings*. These works were so appreciated by his former above-mentioned masters, that they recalled Inghirami from Volterra to Florence, with the view to his ultimately succeeding them in the chairs of higher mathematics and astronomy, employing him meanwhile as instructor in elementary mathematics and physics. This arrangement was most gratifying to Inghirami, as he saw in it the means of dedicating himself fully to the science of the stars, his admiration and ardent love for which had been increased by the recent discovery of Ceres, Pallas, and Juno. But amply furnished as he found himself with the means for advancement in theoretical, he was very deficient in the appliances which are indispensable for practical astronomy.

The observatory founded at the College of S. Giovannino in Florence (which came into the possession of the fathers of the Scuole Pie), by the Sicilian abbot Leonard Ximenes, who died May 3rd, 1786, consisted only of a large hall, which contained a poor transit instrument, a rude movable quadrant, an indifferent mural quadrant, and a fair pendulum clock. A visit in 1807 to the Royal Observatory of Brera, in Milan, directed by Oriani, enlarged Inghirami's acquaintance with practical astronomy, and procured him the friendship of the well-known astronomers Carlini and Santini. His first astronomical work was the publication of an annual ephemeris of occultations of stars; the method of approximately predicting which by an ingenious graphical process, together with the requisite tables, was made public in 1826. He succeeded to the chair of higher mathematics, vacant by the death of Canovai in 1811. His admirable method of instruction, which made his lectures more like scientific and friendly conversations than magisterial lessons, was rewarded by the large number of proficient pupils which came forth from his school. In 1814, he was rejoiced at the addition to his poor observatory of two fine repeating circles by Reichenbach; the larger, eighteen inches in diameter, declared by its maker to be one of the best he ever turned out, was devoted exclusively to astronomical work; the other, eight inches diameter, was used in the survey of Tuscany. This was a work which had never as yet been properly executed, and the first accurate steps in which were made by Baron de Zach, in his visit to Florence in 1808, assisted by Inghirami. The Government consenting to bear the expense of the survey, Inghirami, notwithstanding his other onerous duties, was enabled in 1816 to lay before the public a first specimen of his labours, in

a *Memoir on the Longitude and Latitude of the Cities of Pistoia and of Prato*. Various discrepancies with previous trigonometrical operations by the French led to a mistrust of the small base line, twice carefully measured by De Zach, and at length caused Inghirami to undertake, in 1817, as De Zach himself had often pressed upon him, the measurement of a new one. With the help of several able assistants, this work was completed in one month, and a base line of above five Tuscan miles measured on the fine open plain between Pisa and Livorno; an account of which was given in a very interesting and valuable memoir published in 1818. Great was the gratification of Inghirami when the length of this line concluded by two separate net works of triangles from De Zach's humble base, differed only by half a toise from the actual measurement! There still remained, however, an inexplicable variation in the latitude of Pisa, as determined geodesically and astronomically. . The extension of a triangulation in N. Italy, by Brioschi to Tuscany, brought to light other notable instances both as regards longitude and latitude. A great sensation was in consequence excited amongst astronomers in Germany, France, and Italy, and De Zach, Lindenau, Carlini, and others were busied in the investigation of the subject. De Zach considered that three causes operated. 1. Errors in the instruments and observations. 2. The effect of terrestrial and local attractions on the plumb-line and levels. 3. Irregularities in the conformation of the earth. On the other hand, Baron de Lindenau attributed the discrepancies to the astronomical results, which with existing means he thought were liable at least to an uncertainty of three or four seconds of arc. An attempt to connect the observations of Milan and Florence by fire-signals on an intermediate mountain, distant from each respectively 100 and 39 miles, twice failed. The reason assigned being the prevalence of a stratum of misty air on the surface of the ground after sunset. The third time, in 1825, the signals were well observed before the break of day, and gave a result that differed only five seconds of arc from Brioschi's geodesical conclusion.

Professor Antonelli's elaborate and able discussion of the famous discrepancies above mentioned is full of interest. He gives a table of the latitudes, astronomical and geodesical, of eighteen places in Italy, showing the differences of the two ranging from one or two seconds of arc to above 15″, and in one instance above 30″: he indicates the districts in which the plumb-line is subject to the greatest and to the least deflections; and remarking that the little hills south of Florence exercise a very notable influence, attributable probably more to their greater density than to their volume; he assigns the discrepancy of 8″ encountered by Inghirami between Pisa and Florence, to the greater disturbance suffered by the levels in the last-mentioned locality. He concludes generally that geographical latitudes astronomically determined, and applied to the measurement of degrees of meridians, may be an imperfect means for discovering with great precision the general form and dimensions of the earth, and that so delicate a research requires the concurrence of geodesical resources. This is illustrated by a table in which nine arcs of meridian obtained in Italy with every possibly care, ranging from one degree and upwards to nearly four degrees, and their respective astronomical, geodesical, and theoretical values are exhibited, with their more or less striking differences.*

* In the appendix to the *Connaissance des Temps* for 1827, Arago, in giving an account of these differences in Higher Italy, omitted all mention of Inghirami, who had been the first to call attention to them. Similar anomalies have been found in all other countries.

A controversy was carried on between M. Puissant and the Padre Inghirami relative to a certain measurement in the French trigonometrical operations, which differed considerably from the Italian. Though naturally biased in favour of his revered predecessor and valued teacher, the P. Antonelli treats this subject with great candour, fairness, and temper; and after a most laborious and searching investigation, which he minutely details, gives a verdict in favour of the French geometer.* If a critical selection of the immense mass of observations accumulated in ten years, by the learned Scolopian, showed that he was mistaken in this case, it is no small credit, as Antonelli remarks, "that those observations, in general, fairly bear comparison with others effected with much superior means, and with higher objects in view."

The next labour of Inghirami was the preparation of a copious hypsometrical table for Tuscany, embracing the question of the difference or the identity of level of the Mediterranean and Adriatic Seas. Some observations of rare excellence, under favourable circumstances, seemed to indicate a slight difference; but considering the influence here operative also of local attractions, and the delicacy of the investigation, the Father judiciously refrained from drawing any conclusion. In 1829, he was enabled to lay before the public his long-designed geometrical map of Tuscany, including the confines of the neighbouring States. For the sea-coasts, the charts of Puissant and Captain Smyth furnished materials. The scale was the $\frac{1}{200,000}$th part of the actual size,† and the proportion between the earth's polar and equatorial axes was assumed 309 : 310. This was considered one of the finest works of the kind that had hitherto appeared. Previously to this, however, Inghirami, with other co-adjutors, had published an ephemeris of Venus, Jupiter, and Mars, for navigational purposes. The only attempt in this direction had as yet been made by the Danish Government. Neither of the Boards of Longitude of London or Paris had attended to the subject.‡ The ephemeris appeared in 1820, and in the prefatory remarks, Inghirami refers with complacency to the circumstance, that whether they should be able to continue it as they desired or not, fellow-citizens of the famous Vespucci had the merit of turning to practical account the same method of determining longitudes which that great navigator was the first to conceive.

At the close of 1825, the Royal Academy of Sciences in Berlin proposed that the astronomers of Europe should unite for the construction of a new celestial atlas, with stars down to the ninth or tenth magnitudes, including the space between the parallels of 15° N. and S. Declin., divided by the twenty-four hours of R.A., and to be completed in two years. Inghirami accepted the general invitation, and was intrusted with one of the most difficult portions, the eighteenth hour, very abundant in stars, and moreover traversed by the Milky Way. Using only an annular micrometer applied to a telescope, by Fraunhofer, of five-feet focus, and with the invaluable assistance of his former pupil and then associate, P. Tanzini, an excellent observer, he found himself within a year furnished with over seven thousand observations. These fixed with sufficient

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* The distance in question was made rather too short by Puissant, and considerably too long by Inghirami; the probable errors being 6 and 17 toises respectively, and the true length 11876.30 toises.

† Rather less than $\frac{1}{3}$ in. to a mile.

‡ The distances of the moon from Venus, Mars, Jupiter, and Saturn appeared in the *Connaissance des Temps*, for 1832. The improved *Nautical Almanac* appeared in 1834.

accuracy the positions of 3,750 stars, of which only 1,716 were determined for the first time, the rest being contained in the catalogues of Piazzi, Lalande, and Bessel. Of five or six stars inserted in these catalogues, no trace at all could now be found. Inghirami, who had been the last to receive a commission in this work, was yet the first to remit his portion. It was not only complete in every respect, but engraved, accompanied with letter-press in folio, with every detail of the observations, and subsidiary tables used for their reduction, &c., not omitting distinct mention of the names of those, including seven of his own pupils, to whose unwearied co-operation in the calculations and various departments of the work he was so much indebted for its happy and deservedly applauded issue.

Sensible that mathematics are the foundation and the very life of the sublime science of the stars, this indefatigable philosopher gave especial attention to their promotion. An edition of Gardiner's Logarithms, several times before reprinted in Florence, under the care of the meritorious Fathers Canovai and Del Ricco, was by him improved, extended, and enriched with copious formulæ. He also greatly improved successive editions in Italian of the course of mathematics by the French abbot, Marie, founded on the Lessons of the celebrated La Caille. The preparation of the eighth edition occupied him during 1833, and notwithstanding certain imperfections, unavoidable under the circumstances of its compilation, it was, in the judgment of Antonelli, capable of being easily made one of the best works of the kind that learners could use.

"If," says his biographer, "we call to mind what we have related of the laboriousness of our Inghirami, the range of his acquirements, the acuteness and fertility of his genius, the value of the pains he took for the advancement of the sciences of geodesia, astronomy, and mathematics, and the frank and interesting publicity he always gave to his labours, we shall not be surprised at the universality and splendour of his fame. Almost all the academies and scientific associations of Italy honoured him with diplomas. The Royal Astronomical Society and the Royal Geographical Society of London, and the Geographical Society of Berlin, enrolled him among their members. The Government of Tuscany conferred on him a handsome pension, as a reward for the important services rendered by him to science and to the State; and the Emperor of Austria decorated him with the order of the second class of the Iron Crown; nor did the learned both of the old and the new Continent, who visited la Bella Firenze, leave it without paying him the tribute of their sincere and respectful homage."

Advanced since 1826 to the charge of Superior, or Provincial, as it is termed, of the Scuole Pie in the Grand-Duchy, P. Inghirami strenuously promoted the cause of education. Besides founding a new house of instruction; increasing the subjects of study in the schools; extending the teaching of Italian, and introducing that of Greek, he produced anonymously in 1832, an admirable work on geography, in which lucid scientific exposition is so interspersed with matter of a biographical, artistic, literary, and moral nature, as to invest the whole with a peculiar charm and interest.

Inghirami had been obliged from his youth to use very powerful spectacles. To continuous and severe mental application it may have been partly owing that in 1836 he was unable to read with glasses of any kind. This calamity he bore with calmness and serenity. He continued to preside over his Order in Tuscany, and with the aid of some clever pupil or other, carried on the lessons in higher mathematics and astronomy. In 1839 he underwent a successful operation for cataract, by which his vision was tolerably restored to the end of his life.

During his tedious convalescence, he occupied his mind, though enjoined an almost complete repose from intellectual work, with two projects. The first was the amplification of his beloved observatory, which, notwithstanding its improvement under his directions, was too confined for the new instruments he had acquired and those which he proposed to procure. He was enabled to devise and subsequently carry out a plan for this, which was perfectly satisfactory. The other was to provide more efficiently for the religious instruction of the increased number of the Scolopian pupils. A monumental stone in the "rich and elegant" chapel, constructed for this purpose at his own expense, commemorates the founder's name and his pious object. Called to succeed the Supreme Moderator, or General of the Calasanzian Order in Rome, Inghirami was obliged to remove to that city. His sensitive spirit and timidity in matters of a social and official nature, led to his resignation of this office in a year's time. He had not enough *iron* in his temperament for this new sphere; and Gregory XVI., willing to oblige him, consented that he should return to Tuscany, and thence carry on his functions as Superior during the remainder of their term, which expired in 1848. In the year following Inghirami retired from public and scientific life to devote the remainder of his days to spiritual exercises and contemplation. Not, however, that he was indifferent to his loved sciences. In his humble cell in S. Giovannino, he would cause some good periodical treating on mathematics and astronomy to be read to him, and thus continued to follow with pleasure questions of scientific interest. On the occasion of the great solar eclipse of July 28, 1851, he repaired to the Observatory to take part in its observation, which greatly delighted him. He was then above seventy years of age. From that day his bodily weakness increased till he was confined to his bed, and calmly died, on the 15th August, of congestion of the brain. His funeral was numerously attended by all classes, and a brief but eloquent and affectionate *éloge* pronounced over his remains by Professor Barsottini, of the Scuole Pie. A marble bust of the deceased is in the Ximenian Observatory, and a portrait in the College of S. Giovannino.

Grave in countenance, and sparing of his words, Inghirami did not appear at first sight to possess the kind, amiable, and modest spirit that was enshrined beneath an undemonstrative and seemingly severe exterior. Though he felt keenly, he displayed much patience and calmness under trying circumstances. One day, whilst preparing for an observation in in his observatory, a young assistant overset a fine telescope by Dollond, and was in a state of breathless agitation. Inghirami, seeing the object-glass in fragments, exclaimed, cheerfully, "Oh! we must order another directly from Monaco;'* and this he did without another word about the unfortunate accident. About noon, on the 19th August, 1849, there was a terrible tempest, which suddenly caught the revolving dome of the Observatory, beneath which was the large telescope, and hurled them both into a court of the College. All were afraid to announce such a misfortune to the Father, fearing he would take it so much to heart; but at length, in reply to his repeated inquiries concerning the crash he had heard, they were obliged to tell him that the new telescope (it had hardly been mounted three months), seized by the storm, was lying together with its dome on the roof of the room of the Prefecture of the Schools. "Only think," he said, "where it has gone and tumbled!"

* Where the celebrated optician Reichenbach lived.

(*Senti dov'è ito a cascare!*) and he quietly resumed what he was engaged in.*

The dignified imperturbation of Inghirami, which became proverbial amongst his scholars, sometimes gave way under severe grief. On the occasion of the loss of a most valued pupil of rare promise, who died at the age of eighteen, whilst executing some part of the Tuscan survey, he did not leave his room for three days; and in a letter to Baron De Zach, after speaking of his loss and his great sorrow, he says that if he were to yield to his actual feelings, he should train up no more pupils; not only from the impossibility of his having another who should at all approach the merit of the one thus snatched from him, but to avoid exposing himself ever again to the bitterness of seeing dissipated in a moment the brightest hopes from an education bestowed with so much pains and so much success.

To say that, as Protestants, we find in the subject of this biography some things we could have wished other than they were, and that we are obliged now and then to differ seriously from his esteemed biographer, is to confess—from our point of view—that we find neither in the one nor the other exemption from errors and infirmities that, in however different ways, are found more or less in all of us. It is unnecessary here to dwell further on these points.

Remarking that man has something besides his intellectual faculties to cultivate; and that great endowments, whether in science, literature, or art, unaccompanied by religion, conscience, and right affections, have often rendered their possessors the very reverse of blessings to society, Antonelli thus concludes his account of Inghirami's life and labours :—"Solidity and breadth of literary culture ; vastness of scientific learning ; subtilty, and mental capacity for the most abstruse subjects ; a spirit of observation ; richness of conception ; indefatigable laboriousness ; a power of effectively attending to various important works at the same time ; an extraordinary talent for achieving considerable results with scanty materials and resources ; original and interesting geometrical contributions ; the complete dedication of a long and untiring life to the furtherance of valuable knowledge, and of the public benefit ; the sacrifice of earthly fortune, of the pleasures and lawful affections of the family; conduct in social and sacerdotal life pure, severe, exemplary; sensibility and tenderness of heart; an inflexible love of truth and justice ; a sincere piety from intimate conviction; a living love of God and man. Here, in a few touches, is the spiritual picture of Inghirami ; here are the fine qualities which in no ordinary measure shined in him, and that made him wise amongst the people, esteemed among the learned, celebrated everywhere. He was therefore great as to heart, as to morality, and as to mind ; and it may be affirmed, without fear of exaggeration, that he was a great man !"

Antonelli's excellent memoir is now very scarce ; and the writer of these notices, who is indebted to it for the substance of the greater part of them, and has often borrowed its expressions, desired by them to pay a tribute to the memory of his former instructor, and to present to

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* We may be reminded of an anecdote of our own Colby, whose command over his temper was perfect. Once, while encamped on Slieve Donard, in Ireland, the summit of Sca Fell, in Cumberland, became visible at the distance of 111 miles, and after many trials the instrument was brought to bear upon it. Colby was on the point of successfully finishing his observation, which would have been a geodesical triumph, as including the longest side of a triangle ever attempted, when an officer on entering the observatory accidentally struck his elbow, and threw the telescope off the object. A momentary ejaculation of anger escaped his lips, but though he could not again succeed, and the object was therefore lost, he never afterwards alluded to the subject.—*English Cyclopædia.*

youthful astronomers and mathematicians in this country a few pages which might be read not without some interest and advantage. It was his privilege, forty-five years ago, to study for a time under Inghirami, and to gratify in the halls and the observatory of the palatial College of S. Giovannino an early fondness for the subjects which that eminent, but most unpretending man, as well as other distinguished associates, taught with equal suavity and skill. Both from personal knowledge of P. Inghirami (whom he saw again for the last time in 1840) and his writings, he is able to some extent to testify to the truthfulness of the portraiture drawn by his biographer—a portraiture not to be distrusted because it seems to glow with the warm tints of an Italian sky—and he will rejoice if, by this slight sketch, the character and labours of one who was so highly esteemed in other countries, shall be still more widely and deservedly appreciated in our own.

G. J. W.

Light Science for Leisure Hours. By Richard A. Proctor, B.A., F.R.A.S. London: Longmans.

It has been many times a subject of regret that the valuable essays which so frequently appear in the daily and weekly press should not be preserved in a convenient form for future reference; written as they are, while the subjects are fresh in our minds, they cannot fail to be faithful and interesting records of the matters of which they treat. It is impossible that we can have been alone in the thought that Mr. Proctor's excellent contributions of this nature are deserving of preservation, and it is therefore gratifying to find them now before us, so collected as to form a volume of like character to his other recent works, "The Sun," "Other Worlds than ours," &c. Although the papers in the present book are chiefly astronomical, Mr. Proctor's powers have not been entirely confined to that subject, and the titles of some of the papers—"The Gulf Stream," "Floods in Switzerland," "Mont Cenis Tunnel," "Long Shots," "Influence of Marriage on the Death Rate," "Betting on Horse Races," &c.—show that he has applied his excellent powers as a writer and mathematician to subjects of very varied character. We feel sure that all who are acquainted with Mr. Proctor's excellent writings will be glad to meet again his fugitive pieces in a convenient form for the library.

THE GREAT NEBULA OF ETA ARGUS.

Our good Correspondent in New South Wales, Mr. McDonnell, has favoured us with a copy of the *Sydney Morning Herald*, of May 13 last, from which we extract the following report of a very interesting paper by Mr. C. H. Russell, the Government Astronomer, read at the meeting of the Royal Society of New South Wales, on the 10th of May this year:—

In the months of January and February of the present year I surveyed carefully, with the fine refractor of the Sydney Observatory, the stars and nebula about the remarkable variable Eta Argus. The observations I have already printed and sent to Sir John Herschel, who has shown the greatest interest in the changes which have from time to time been reported in this object, and whose beautiful monograph of 1843 enables us

now to trace some of the most wonderful changes that have ever been witnessed by astronomers.

I then omitted some results of the survey, as I did not wish to give anything as evidence which might be biased by my personal convictions. Upon these I have based the few remarks I have to make this evening. And as the subject may be new to some of the members of this society, a few historical notes may not be out of place.

In 1677, when observed by Halley, at St. Helena, Eta Argus was of the fourth magnitude, thence to 1751 it does not appear to have been observed, but in that year Lacaille called it second magnitude. Another long interval, and Mr. Burchell—1811 to 1815—noticed that it was fourth magnitude. 1822 Fallows calls it second magnitude; and in 1827 Burchell noticed that it had increased to the first magnitude; and writing to Mr. J. Duncan, in 1827, says, "I am curious to know whether any one has observed that Eta Argus, which is marked as fourth magnitude, and was always so when I was in Africa, is now of the first magnitude, or as large as Alpha Crucis." No one, however, but himself seems to have noticed it, and he did not publish the fact. When Sir John Herschel went to the Cape in 1834, he began his observations on Eta Argus, which was then about the second magnitude, and continued so up to November, 1837; on the 16th of December, when again examining the star, he was very much surprised to find it had increased to the first magnitude, and was one of the brightest stars in the heavens. This naturally excited his curiosity, and led him to watch it closely to the following April (1838), when his departure from the Cape prevented further observations of it. Up to the 2nd of January, 1838, it continued to increase, and was then equal to Alpha Centauri; after this it faded gradually, and on the 14th of April was about equal to Aldebran and Leonis.

In 1843, Sir Thomas Maclear, at the Cape, observed it much brighter than Alpha Centauri, and rather brighter than Canopus, and on the 14th of March thought it almost equal to Sirius. As Sir John Herschel estimated Canopus as double, and Sirius as quadruple of Alpha Centauri, Eta was at that time probably triple Alpha Centauri; it then faded again, but in 1845 was brighter than Canopus, and had been so for some time. These observations proved the extraordinary fluctuations of the light of this star, and made it one of the most interesting objects in the heavens, which the observations of various astronomers since have in no way tended to lessen. From their published results I have, for convenient reference, drawn up the attached list. It contains the observations from which Professor Loomis, in April, 1869, deduced the generally accepted period of 67 years, and some additional ones.

Professor Wolf, in 1863, thought that a period of forty-six years would satisfy the observations; but Professor Loomis found that subsequent observations, especially those of Mr. Tebbutt, could not be satisfiedexcept by assuming a longer period, and gives the result of his investigations in vol. xxviii. R.A.S. Notices. His diagram exhibits minor fluctuations of light, which may, perhaps, in some cases be accounted for by errors in the observations but not in all; and there can be no doubt that Eta is subject to strange minor fluctuations of light in addition to its periodical variation.

Sir John Herschel (in 1843), (at page 36 of the Cape Observations), says "A strange field of speculation is opened up by this phenomenon—the temporary stars heretofore recorded have all become totally extinct. Variable stars, so far as they have been attended to, have exhibited periodical alterations in some degree at least regular, of splendour and comparative obscurity. But here we have a star fitfully variable to an

astonishing extent, and whose fluctuations are spread over centuries. Its future career will be a subject of high physical interest." Since 1845 Eta has gradually faded, and is now (1871) only a 7th magnitude star; less than it has ever been observed before, and, perhaps, going like all other temporary stars into darkness: certainly with its fading light throwing many dark shadows in the way of any speculations on the constitution of temporary stars.

Of the nebula about it little notice seems to have been taken for a number of years; the difficulty of drawing it would deter most observers, and the differences observed naturally attributed to the difference in the instruments. The Cape drawing being always received as its appearance in a large telescope; for this drawing the observations extended over the years 1834, 5, 6, 7, and part of 8, and nothing was then seen to lead to the supposition that any change was going on in the nebula or stars.

(*To be continued.*)

THE PLANETS FOR AUGUST.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	10 5 30	+12 46½	5″·6	1 26·6
	15th	11 17 5	3 29½	6″·6	1 43·0
Venus ...	1st	11 34 19	+1 17	28″·4	2 25·2
	15th	12 8 22	−4 37	34″·8	2 34·1
Mars ...	1st	13 26 4	−9 36	7″·8	4 46·7
	15th	13 57 45	12 48	7″·4	4 23·2
Saturn ...	1st	18 18 41	−22 40½	16″·4	9 38·5
	15th	18 15 58	22 44	16″·2	8 48·9
Neptune ...	29th	1 30 41	+7 37½	2″·0	14.59·2

Mercury passes the meridian an hour and a half after noon, and consequently is an evening star and fairly visible.

Venus sets earlier each day; at the end of the month only a few minutes after the sun.

Mars is still to be seen, but only for a short time after sunset. He sets about two hours and a quarter after the sun at the beginning of the month, the interval gradually decreasing.

Saturn is well situated for observation through the greater part of the night.

ASTRONOMICAL OCCURRENCES FOR AUGUST, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn
Tues	1	 6 14 7 50	Sidereal Time at Mean Noon, 8h. 38m. 36·81s. Conjunction of Mars and h Virginis 0° 7′ N. Conjunction of Mercury and α Leonis (5m.·6) W.	2nd Sh. I.	16 17	9 38·5
Wed	2	9 26	Occultation reappearance of τ^2 Aquarii (4)			9 34·3
Thur	3		Sun's Meridian Passage, 5m. 56·58s. after Mean Noon	2nd Oc. R.	14 26	9 30·2
Fri	4			1st Sh. I.	16 13	9 26·0
Sat	5	1 55 5 12	Conjunction of Mars and α Virginis (16m.·2) W. Conjunction of Mercury and ρ Leonis (3m.·4) W.	1st Oc. R.	16 27	9 21·9
Sun	6					9 17·7
Mon	7	16 23	☾ Moon's Last Quarter			9 13·6
Tues	8					9 9·5
Wed	9					9 5·4
Thur	10	15 4 15 48	Occultation of o Tauri (6) Reappearance of ditto Saturn's Ring: Major Axis=40″·38 Minor Axis=17″·89			9 1·2
Fri	11	12 41 13 22	Occultation reappearance of 6 Geminorum (6) Near approach of η Geminorum ($3\frac{1}{2}$)			8 57·1
Sat	12	22 58	Conjunction of Moon and Jupiter, 1° 32′ S.	1st Ec. D.	15 29 41	8 53·0
Sun	13	19 8	Conjunction of Moon and Uranus, 1° 57′ S.	1st Sh. E. 1st Tr. E.	14 54 15 37	8 48·9
Mon	14					8 44·8
Tues	15	16 1	● New Moon Illuminated portion of disc of Venus=0·307 ,, Mars=0·886			8 40·7

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn
Wed	16	0 27	Sidereal Time at Mean Noon, 9h. 37m. 45·13s. Conjunction of Jupiter and δ Geminorum (8m.·4) W.			8 36·7
Thur	17	19 32	Conjunction of Moon and Mercury, 7° 5′ S.	2nd Ec. D.	15 41 40	8 32·6
Fri	18	18 33	Conjunction of Moon and Venus, 9° 54′ S.	1 Tr. I.	15 28	8 28·5
Sat	19		Sun's Meridian Passage 3m. 30·22s. after Mean Noon	1st Sh. E. 2nd Tr. E.	13 33 15 11	8 24·4
Sun	20		Venus at greatest brilliancy	1st Sh. I. 1st Tr. I. 1st Sh. E.	14 30 15 19 16 48	8 20·4
Mon	21	2 45	Conjunction of Moon and Mars, 5° 16′ S.	1st Oc. R.	14 57	8 16·3
Tues	22	23 35	☽ Moon's First Quarter	3rd Sh. E. 3rd Tr. I.	14 20 14 30	Moon. 5 7·9
Wed	23					6 1·9
Thur	24					6 59·3
Fri	25	8 13	Conjunction of Moon and Saturn, 1° 3′ N.			7 59·6
Sat	26	7 14 8 20	Occultation of χ′ Sagittarii (6) Reappearance of ditto	2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	13 17 15 6 16 8	9 1·2
Sun	27			1st Sh. I.	16 24	10 1·9
Mon	28	12 30 15 15	Near approach of ε Capricorni (4½) Occultation of κ Capricorni (5)	1st Ec. D. 1st Oc. R.	13 45 23 16 57	10 59·9
Tues	29	18 20	○ Full Moon	1st Sh. E. 1st Tr. E. 3rd Sh. I.	13 10 14 7 15 7	11 54·3
Wed	30		Saturn's Ring: Major Axis=39″·26 Minor Axis=17″·47			12 45·0
Thur	31					13 32·6

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN AUGUST, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight. ° ′	Objects to be observed.
18	... 147 16·7	... Mare Crisium, direction of the central ridges.
19	... 134 4·4	... Cleomedes, Burckhardt, Geminus (*a*).
20	... 122 7·1	... Macrobius, Proclus, Mt. Glaisher (*b*).
21	... 109 17·3	... Mare Nectaris, eastern part.
22	. 96 18·8	... Aliacensis, Werner (*c*), Reaumur.
23	... 83 12·2	... Region north of Aristoteles.
24	... 69 58·6	... Sasserides, Pietel, Sassure.
25	... 56 39 2	... Carlini, Sinus Iridum (*d*), Lambert.
26	... 43 16·2	... Gassendi, group of central mountains (*e*).
27	... 29 53·4	... Anaximander, Galileo, Lehmann.
28	... 16 35·0	... Bettinus, Kercher, Wilson.
29	... 3 26·2	... Zuchius, Hausen, Bailly.
30	... —9 27·9	... Wilhelm, Humboldt, Phillips (*f*).
31	...—22 3·3	... Objects between the west limb and terminator.

For additional objects consult the lists for April and June.

The moon is now approaching a state of mean libration, which it attains about October 4, 1871. From the 18th to the 24th of August, objects will be north and west of their mean places on the apparent disc. Afterwards they will be south and east. As the morning terminator passes over objects with west longitude, the visual angle will be unfavourable for studying the interiors of large formations, but favourable for observing decreasing foreshortening. The state of the apparent disc on the 24th will not deviate greatly from that of mean libration.

Guttemberg and Stöfler.

In the *English Mechanic*, No. 326, June 23rd, p. 336, will be found a sketch of Guttemberg and its surroundings, by Birmingham, the discoverer of T coronæ. See also the list for July note (*a*). Attention is particularly directed to an interior ring S.E. of the ring on the N.W. of Guttemberg, both were first recognised by Mr. Birmingham in 1869. A sketch of Stöfler, by the same obesrver, will be found in the *English Mechanic*, No. 328, July 7, p. 386.

(*a*) Drawings and descriptions of these objects will be valuable.

(*b*) A high mountain near Proclus, named by the late Dr. Lee to commemorate the highest balloon ascent.

(*c*) The Rev. T. W. Webb announces that the bright spot in Werner, which according to Beer and Mädler equalled if not exceeded Aristarchus in brilliancy, has certainly faded, and is now below many other luminous spots on the disc.

(*d*) The system of ridges from La Place to Heraclides is well worthy of study.

(*e*) Attention is directed to Gassendi, that its earliest illumination may be caught, as good drawings and descriptions of the interior are very desirable.

(*f*) These formations very near the west limb may probably be seen, as by libration they are east of their mean places.

OBSERVATIONS FOR AUGUST, 1871.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, midnight		60°N.	0°	60°S.
		SUNSET.		
1871.	August 1	+68°·6	+66°·9	+65°·2
	2	56·4	54·7	52·9
	3	44·3	42·5	40·7
	4	32·1	30·3	28·5
	5	20·0	18·1	16·2
	6	+7·8	+5·9	+4·0
	7	−4·4	−6·3	−8·3
	8	16·6	18·5	20·5
	9	28·8	30·8	32·8
	10	41·0	43·0	45·0
	11	53·2	55·2	57·3
	12	65·4	67·5	69·6
	13	−77·6	−79·7	−81·8
		SUNRISE.		
	17	+49·1	+51·3	+53·5
	18	36·8	39·1	41·3
	19	24·6	26·8	29·1
	20	12·3	14·6	16·9
	21	+0·1	+2·4	+4·7
	22	−12·2	−9·8	−7·5
	23	24·4	22·0	19·7
	24	36·6	34·2	31·9
	25	48·8	46·4	44·0
	26	61·1	58·6	56·2
	27	73·3	70·8	68·4
	28	−85·5	−83·0	−80·5
		SUNSET.		
	30	+75·1	+72·6	+70·1
	31	+63·0	+60·5	+57·9

M.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Sept. 1871.

Cotsworth, H.
Hemming, Rev. B. F.
Jackson-Gwilt, Mrs.

To Dec. 1871.

Andrews, W.
Banks, W. L.
Fleming, Rev. D.
Glover, E.
Knott, G.
Lee, Allen
Noble, Capt. W.
Smelt, Rev. M. A.

To Jan. 1872.

Green, S.
McAdam, J. V.

To March, 1872.

Elger, T. G.

To June, 1872.

Forest School, Walthamstow.

July 24, 1871. Subscriptions after this date in our next.

Instruments, &c., For Sale or Wanted.

These Notices, which must in all cases be paid for in advance, are inserted at the rate of *One Shilling* for *Twenty Words* or under; half-price only will be charged upon repetition, if no alteration is required. When the address is not given, application may be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—The Notice will be withdrawn should the payment not be renewed.

FOR SALE.—A Telescope, by *Slater*, 6 inches aperture; 6 ft. 6 in. focus. Equatorial mounting of the best description, with circles, &c. 185

FOR SALE.—Telescope, equatorially mounted, by *Slugg*, of Manchester, 3⅝ inches aperture, 5ft. 2 in. focus. With 3 Eyepieces, Diagonal Reflecting Prism, &c., in oak case. 189

FINE REFRACTOR FOR SALE, three inches clear aperture, by COOKE & SONS, of York; and an Iron Equatorial Mounting, by TAYLOR, Engineer, Birmingham. With Eyepieces and two Diagonal Prisms for Sun and Stars. Price £21. 188

WANTED, a Telescope, by a good maker, not less than 7 inches aperture, and long focus, equatorially mounted. 186

THE BEDFORD CATALOGUE.—Wanted, a copy of "Smyth's Cycle of Celestial Objects," in fair condition. 190

TO CORRESPONDENTS.

Several Papers are deferred for want of space.

A Correspondent asks, "Who was that Sir Michael Newton who attended Sir J. Herschel's funeral as chief mourner?"

Erratum in No. 103, p. 168, line 7, for *chime* read *drive.*

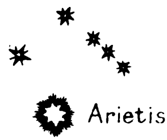
THE INDEX AND TITLE to the last Volume of the *Register* is, we regret to say, not yet ready, but we hope will soon be completed; due notice will be given to Subscribers.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

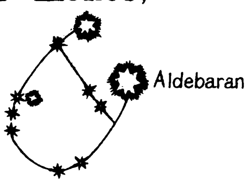
The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astral Cipher Emblems of the Signs.

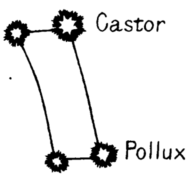
♈ Aries,



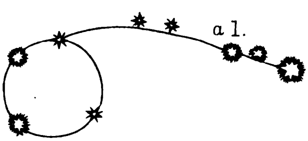
♉ Taurus,



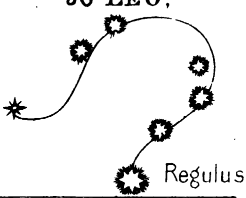
♊ Gemini,



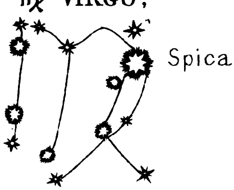
♋ Cancer,



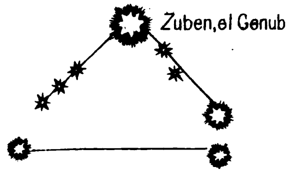
♌ Leo,



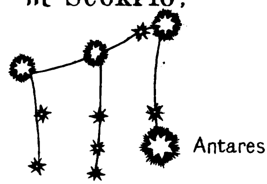
♍ Virgo,



♎ Libra,

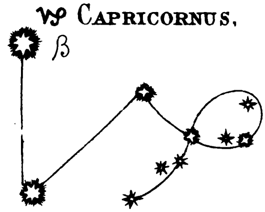


♏ Scorpio,

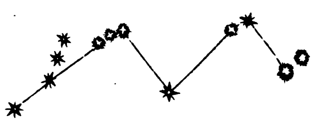


♐ Sagittarius,

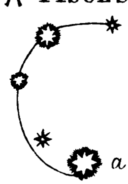
♑ Capricornus,



♒ Aquarius,



♓ Pisces,



The Astronomical Register.

No. 105. SEPTEMBER. 1871.

ASTRAL ORIGIN OF THE CIPHER EMBLEMS OF ASTRONOMY.

BY THE REV. J. H. BROOME, VICAR OF HOUGHTON, NORFOLK.

Little, if anything, appears to be known as to the origin of the cipher emblems which express the Twelve Signs of the Zodiac.

Desirous of ascertaining all that was known on the subject, the author asked one of the most eminent astronomers of the day for information. All that he obtained from so highly accredited an authority was, "That neither himself, nor did he think any one else could give a satisfactory answer to the question, the emblems appearing to have their origin in a very remote antiquity."

As to astronomy itself, it was the opinion of Josephus, and more ancient authorities likewise, that this science commenced in the family of Seth, the son of Adam. (Josephus, B. I. c. III. & IV. See also "Notes to Gill's Com. on Genesis," where the names of ancient writers—Jewish, Persian, and Arabian—are given as to the truth of this testimony.) Now, if the statements we find given in the authors referred to be true, it will go far to account for the fact, that so extremely little is known in our day of the origin of these emblems. Is not simplicity the characteristic feature of things most ancient? In the earliest

stages of our world's history, its inhabitants had comparatively but few speaking objects before their eyes, in the use of which, as by emblems, they could fitly express their ideas. For the convenience of expressing by ciphers the Twelve Signs of the Zodiac, would not the ancient sages naturally have recourse to *astronomy* itself, in its suggestive starry configurations, and having, with a strong vision in a clear Eastern sky, carefully marked out in each of the Twelve Signs its own appropriate ciphers, have they not come down to us through a long vista of many ages?

Impressed with this thought, the author most carefully set to work to examine the starry configurations of the Twelve Signs, feeling assured if his theory was a right one, he would find that each one of the cipher emblems would be found to consist, or include at least, the *chiefest* stars in each sign. The very close resemblance of the stars to each appropriate cipher may be seen on the plate. Surely such repeated copies, as one is from another, cannot be attributed merely to so many coincidences; for let the objector, in any one of the instances drawn on the plate, make a transposition, that is, attempt to find the shape of one of the twelve cipher emblems in any other sign (taking in the chief stars) than that in which it ought to appear, and he will find his labour to be in vain.

Plato in Cratylus says: "Names are pictures of things, having some resemblance to the things named." Applying the remark to the stars which give name to the sign Aries, we see some resemblance to the side horns of a ram, as given in its appropriate cipher. In Taurus, likewise, the upper stars resemble the two horns of a bull. In Gemini, it is the uniting of two similar figures which gives one an idea of the twin-union. In Cancer, four circular stars give a notion of the crab. In Leo, not a faint conception is given of the attitude in which a lion stands when he is facing you. In the stars of Virgo, we can trace no resemblance to a virgin, save that its chief star, Spica, seems carried as by a virgin. In Libra, the resemblance of its stars to a balance is plainly drawn. In Scorpio, nothing but the protrusion, as it were, of its chief star, Antares, as in its cipher, reminds us of the scorpion's sting. Sagittarius is shaped not unlike an arrow. In Capricornus, an imaginative person only will see any resemblance to the goat. Aquarius reminds us of the agitated waves of the sea. In Pisces, one figure is drawn as in Cancer. It may represent a fish when *bent;* but, however this may be, taking the twelve ciphers together, they either more or less resemble the objects they represent, and the starry configurations also of the Twelve Signs of the Zodiac.

If the antediluvians found appropriate ciphers in the Twelve

Signs of the Zodiac to represent the signs themselves, it is but going one step farther to say, that they found in the natural configurations of the constellations their one primæval alphabet.

That astronomy and the primæval alphabet originated much about the same time, was an ancient belief, as it is by some Jewish Rabbins in our day. In the December Number of the *Astronomical Register* for 1870, the author has given drawings from the stars of what seems to come extremely close to the true primæval alphabet. These drawings are now published by Macintosh.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

ON THE CONTEMPLATION OF THE SIDEREAL HEAVENS.

In the concluding lines of the *Prolegomena* to the "*Bedford Catalogue*," Admiral Smyth says of the reader who has accompanied him through them—"Armed with a telescope he may immediately employ his time to advantage; and even if without one, his contemplation of celestial objects must have increased in interest." "Look up," said Richter, "and behold the eternal fields of light which lie around the throne of God! Had the stars never appeared in the firmament, to man there would have been no heavens; but he would have laid himself down to his last sleep in a spirit of anguish, as upon a gloomy earth, vaulted over by a material arch, solid and impervious." To the thoughtful person, even without optical appliances, the survey of the heavens is indeed delightful; and the well provided observer, too, will at times experience the enjoyment of leaving his instruments, and abandoning himself beneath the canopy of the skies to the contemplation of those "eternal fields of light" with which modern discovery has linked such wonderful associations. Not that one unprovided with the humblest telescope is precluded from useful observation. He can trace and map out, by careful alignments, the paths of planets and comets. He can note colours and magnitudes, and to some extent variations in the latter. Meteors, periodical and irregular, various phenomena in eclipses come within his reach: and he can rate his watch to a considerable degree of accuracy, by the disappearance of stars behind a building. But apart from all this, there is something soothing to the mind in the contemplation of the starry vault after the business and cares of the day are past. There is a music in the spheres perceptible to the spirit, though not to the ear; and the grand but noiseless march of the constellations seems to reprove the often undue place we are apt to give to our terrestrial pleasures and pains. And, in the presence of such glories, do we not learn a lesson of humility; and is not a sense of our own littleness pressed upon us, that can find no better expression than in the inspired language of the Psalmist (Ps. viii. 3, 4)? The honours, what-

ever they be, the rivalries and contentions of the world must seem trifling, as we gaze upon the bright and distant orbs that shine in the immensity of space; and whose general apparent fixity strikingly contrasts, as it ever has done, with the changeableness and the vicissitudes of mundane things. For we survey in the arrangement of the stars, the same, or at least the little altered, constellations beheld by the earliest observers of our race: and we are in a manner brought into fellowship with the host of astronomers of all ages who studied the stars before us, and read, so to speak, out of the same book.

The contemplation, however, of the nocturnal skies, derives a vastly greater interest when we connect with it the light which modern science has thrown upon the scale of the visible universe. Illustrations are common in our astronomical books. Let us choose one which may be easily carried in the memory, and let us take the distance of Neptune* as a modulus for that of the nearest stars The distance of Neptune being thirty times that of the earth from the sun, we shall find that an express train, moving at the rate of sixty miles an hour without stopping, would reach that planet in 5,219 years.† Supposing some such rapid locomotion possible, and that Enoch (born according to the common chronology, B.C. 3382) had availed himself of it when he was thirty-four years of age, he would but just now have arrived at Neptune; and from thence he would behold the sun of the same apparent magnitude as Venus, when a morning or evening star, only immensely more bright. In the general aspect of the heavens, and configuration of the constellations, he would see no difference. The same star-maps he might have taken with him would serve there as well as here; the comparatively small changes occasioned by proper motions in the five thousand years of his journey alone excepted. And supposing such a journey instantaneously accomplished, a star would only suffer a displacement of half a minute of arc, at the most, from the position in which it would be viewed from the earth. This consideration, that the change of our point of view from the earth to Neptune would make no difference in the aspect of the heavens to the naked eye, is well calculated to give an idea of the vastness of the universe.

Using now the modulus we have chosen to measure the distance of the nearest fixed stars, we find it must be, in round numbers, 6,900 times that of Neptune from the sun. But this, it must be remembered, is a minimum; and very many, if not most, are probably far more remote. As far as *space*, then, is in question, there would be room for not a few more planets in our system far more distant than even Neptune, without their being disturbed by the attraction of the stars. The great comet of 1680 recedes, it has been supposed, to a distance from the sun greater by more than twenty-eight times that of Neptune; from which the apparent diameter of the sun would be only 2″; and the aphelion distance of the comet II. of 1844, to which a period of 100,000 years has been assigned, has been computed to be above 142 times the distance of Neptune from the sun. These cometary calculations, however, are to be regarded as far from being entirely reliable.

The enormous scale of the universe is also forcibly brought home to us, when we reflect that although we change our position every year in

* The name given to the remotest known planet happens to accord well with the belief held by many of the Hebrews, and some of the Christian Fathers in a super-celestial ocean, which has also appeared to some countenanced by various passages of Scripture. Ps. cxlviii. 4, &c.

† It would reach the moon in five months and a-half.

space more than 150 millions of miles—that being the sun's rate of motion, together with the whole solar system—and although many of the stars themselves—probably all—are in motion, and some of them far more rapidly, the eye detects no change in the heavens, from year to year, or from century to century. Repose is in reality nowhere: notwithstanding that immense distances and universal motion would persuade our vision that it is found among the stars. The Great Bear, Orion, and the Pleiades, are beheld by us as they were seen by the contemporaries of Job and Homer.

If it is impossible to think of the awful space that separates our sun and the remotest planet, or comet, that owes allegiance to it, from the nearest "fixed" stars—space of a temperature intensely cold,* filled with the etherial medium, and traversed by numberless meteoric bodies and comets; occupied, too, in parts, perhaps, by masses of gaseous or nebulous matter—there is another consideration which enhances the interest with which we contemplate the starry heavens, and that is their probably vast antiquity. We have not, it is true, the same sort of evidence that geology affords of the enormous age of our own globe, yet the antiquity of the latter affords a fair presumption of a still greater for many other celestial bodies. It would seem also that the grandeur itself of the scale of the universe, and the time required for the revolutions of many of the multiple stars is an argument either for a designed vast period of future duration, or one of past existence; while both may very likely be true. The element of time, we might infer, would harmonise in its proportions with that of space. Some would, probably, now at least hesitate to acquiesce in the conclusion of the elder Herschel in 1802, when he wrote as follows; "Hence it follows, that the rays of the light of the remotest nebulæ must have been almost two millions of years on their way, and that consequently so many years ago this object must already have had an existence in the sidereal heavens, in order to send out those rays by which we now perceive it." But in the various stages of apparent condensation of the nebulæ, from the diffuse mist to the perfect star, we still appear to behold in these wonderful bodies evidence of different degrees of high antiquity. In a paper in the *Cornhill Magazine* for July, entitled, "The Herschels and the Star depths," the writer,† alluding to Sir William Herschel's later investigations, and in reference to "different milky nebulæ which seemed to belong to different stages of growth, from an exceedingly faint and altogether irregular nebulosity, to rounded nebulæ, nebulæ with faint centres, nebulæ with bright centres, nebulæ consisting almost wholly of a bright central light (the outer portion being scarcely discernible), and, finally, nebulous stars—this being the last recognisable stage in the progress to actual stars or suns," observes, "There is something singularly impressive in the ideas suggested by this theory, whether as regards extension of space or duration of time."

On the supposition that the stars are not older than the earth, it would only have been by degrees that their light, according to their various distances, reached it; and, supposing that a human being existed in it at its first creation, he would have seen a sky void of stars; and not till the

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* Estimated as not higher than —60°; but supposed by some to be as low as —80°, and by others even much less.

† Presumably one well-known as the author of various valuable works. He has done a good service in calling attention, in the above cited paper, to the importance of distinguishing between the earlier and more recent conclusions of our great astronomer.

lapse of many years would he have beheld it as we see it now.* From the beautiful passage (Job xxxviii. 7), however, it may be very well inferred that the stars, as well as the angels, had been created prior to the earth. Otherwise, for a long time the striking description (apart from Revelation), by Jean Paul Richter, would have been realised; and the glory of God would but in an inferior degree have been declared by the heavens, and his handywork shown by the firmament.

As the proficient scholar is not always occupied with questions of criticism, but can meet the ordinary reader on common ground in the enjoyment, for its own sake, of such works as those of Shakspeare and Homer; so may the practical observer and the hard-headed calculator sometimes find, away from their especial provinces, the elevating pleasure in the simple survey of the heavens shared with them by the humblest star-gazer. It is good sometimes to read the spangled scroll, nightly unrolled to the view of all, in company with one's fellow men of ordinary intelligence and information. The eye need not always be at the telescope, nor the mind for ever engrossed with equations of condition. Some of us may be able to recall the early zest and eager delight with which we gave our minds to the sublime spectacle, and the transcendent associations of the heavens; or we may remember the eclipse, or the comet, or other phenomenon, which induced our first attachment to astronomy, or revived the flame of an earlier love. Since then we may have been enabled both to see and to know a little more; and it is well if subsequent learning, or mechanical routine, or calculations, familiarity with diagrams and figures, etc., have not in part impaired the freshness of our former feelings. Observatory and library are not essential, that we may listen pleasantly and profitably to the instruction which the star-lit heavens impart in a language intelligible throughout all the world. And with an acquaintance with astronomical facts, probably greater than the psalmist possessed,† our ear may appreciate even more sensibly than his, the sound of the harp-strings which goes out through all the earth. (Ps. xix. 2—4.)

GEORGE J. WALKER.

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* "Du reste, si cette hypothese [of one sole creation], tout à fait contraire au système d'une création primitive et d'une organisation posterieure des corps célestes qui en aurait été l'objet, était exacte, le spectacle que le ciel aurait présenté aux premiers âges du monde, à Adam et à ses descendants, aurait été aussi extraordinaire que singulier. Le premier homme n'aurait pas vu, lors de sa venue sur la terre, une seule étoile au ciel; le soleil, la lune, et les planètes auraient été les seules astres, qu'il y auraient apperçus et dont il aurait joui pendant les premières six années. Au delà de cette epoque, les étoiles auraient commencé à apparaître successivement et dans un ordre inverse de leur distance à la terre. La voie lactée n'aurait donc présenté l'aspect, qu'elle offre actuellement, qu'au delà d'un certain nombre de siècles. Enfin aujourd'hui encore des étoiles et des nébuleuses devraient se montrer pour la premiere fois dans le ciel. Il faut l'avouer, de pareilles conséquences sont tout à fait inadmissibles; dès lors on est en droit de rejeter la supposition qui y a donné lieu. La création des étoiles et des nébuleuses a donc precédé la création de l'homme actuel d'un grand nombre de siècles," etc. Marcel de Serres, *De la Creation de la terre et des Corps Celestes.* Paris, 1843. p. 17.

† *Kōkhav*, "star," in Hebrew and Arabic, is derived by Gesenius from the unused root *Khavav*, to roll up; so that its literal meaning is a globe or ball. It is notable that there is only one other word derived from this root in the Hebrew Bible, *Kabbon*, the name of a town in the tribe of Judah. Our own word star (as well as the Greek, *asteer;* the Latin, *aster, astrum, stella;* the Persian, *sitárah;* the Anglo-Saxon, *steorra;* the German, *stern*, etc.) is from the Sanskrit, *târá* (Zend, *stàré*), from the root *stri*, to strew. Compare Milton's, "And sow'd with starrs the heav'n thick as a field."—*Par. Lost*, vii. Conclusions based on etymology are often precarious; and it is only suggested with diffidence that the Hebrew word may possibly indicate a primeval knowledge of the nature of the stars, which was not preserved in the Arian branch of the human race.

DESIDERATA.

Sir,—I have no doubt that the intimation of "Habens" will be received with satisfaction by a considerable number of amateurs, whose zeal exceeds their pecuniary resources. I cannot, however, quite understand how a 10-inch pendulum can be made to beat seconds. I should have fancied that it would have beaten *half* seconds rather. I am familiar with Dent's Dipleidoscope, which scarcely seems to me to obviate the necessity for a cheap form of transit. Of course, if the observer should happen to be on the spot at the precise instant of apparent noon, *and the sun should happen to be shining*, the Dipleidoscope is as elegant and accurate an instrument of the sort, as need be wished for. I confess, however, to a personal feeling as to the desirability of having the 147 *Nautical Almanac* stars to select from; and here the Dipleidoscope certainly can hardly be said to be practically available.

I am sure that Mr. Hind ought to be truly grateful to (that very Earl Russell of Astronomers) Mr. G. J. Walker, for his able advocacy of the "Rest and be thankful" policy, in connection with the publication over which he presides. "The Eclipses of Jupiter's Satellites," says the *Nautical Almanac*, on the very page where Mr. W. quotes, "especially of the first, afford us perhaps the readiest means of determining the longitude." Just so; and yet we are told that this is a "question of . . . . no navigational value;" that we must hope that the errors "are approaching their maximum" (on the principle, I suppose, that "when things get to the worst they are sure to mend"), and so on. If, then, I comprehend Mr. Walker's notion, it is that observations should continue to be made, and suffered to accumulate, at Greenwich, until some Swede, or Frenchman, or German shall take it into his head to utilise them, by calculating fresh tables from them; and that then—but not till then—the *Nautical Almanac* computers are to employ improved data for the emendation of the terribly misleadlng pages which are now published year after year, *malgre* Mr. Walker, without any warning at all. Verily this comes to what I said, about the sole duty of the Superintendent consisting of seeing that his subordinates do not take out the wrong logarithms. Will Mr. Hind himself, in words, accept and defend this definition of his position?

I am, Sir, obediently yours,

3rd August, 1871. EGENS.

Sir,—I feel very sorry for "*Habens*'" knowledge of the requirements of practical astronomical horology, when he recommends such a sidereal clock as he describes, with a 10-inch pendulum and chronometer escapement, and if it is a spring clock, as I suspect it is, the bare idea of recommending it for astronomical purposes is simply absurd. A far superior timekeeper can be had in any old eight-day long cased clock with 40-in. pendulum, driven by a weight, which can be "picked up" in almost any of the second-hand shops for less money than the sum named by "*Habens*," and I would suggest to Mr. Cocks, of Wells-next-the-Sea, that he should give up the idea of such a thing for *astronomical purposes*, for I am convinced that a clock can be produced for 5*l*, with a Graham's

dead-beat escapement, which is far easier to make, and therefore cheaper, simpler in its action, not so liable to derangement, and for time-keeping is only rivalled by the more expensive gravity escapement, a compensated pendulum consisting of a deal rod and a leaden bob 14-inches high, and driven by a weight, with maintaining power. The rate of such a clock as this is very little inferior to that of the best Regulator costing 40*l* or 50*l*, or more.

I am, Sir, yours, &c.,

Whitburn, near Sunderland. JOHN G. ALLISON.

THE NAUTICAL ALMANAC.

Sir,—In connection with a letter in your pages wherein Mr. G. J. Walker does me the honour to refer to me by name, I would merely observe that I do not believe that my acquaintance "with the whole history of the perturbations of Uranus, leading to the astonishing discovery of Neptune," would disappoint even his expectations; inasmuch as I have read (for my sins) almost every word, I think, that has ever been published on that subject in the English language. I must add though that the errors in the tabular place of Uranus are perfectly well known, and their direction sufficiently well ascertained to have enabled the computers of the pages of occultations in the *Nautical Almanac* to have introduced a supplementary correction; the more especially as the times given are those about which the occultations *are to be looked out for.* I never dreamed that this correction had not been made, that it was not only shown in what a perfunctory and purely mechanical way the work is done. And again, with regard to Jupiter's Satellites, with reference to the eclipses of which Mr. Walker makes the remarkable assertion that they have "no navigational value." Why the very *Nautical Almanac* prefaces its caution by saying, that "The Eclipses of Jupiter's Satellites, especially of the first, afford us, perhaps, the readiest means of determining the longitude;" and I can certify that the disappearance of the first—and even that of the second—in a telescope of less than two inches in aperture, is a very sharply defined phenomena indeed. There are plenty of nights on board ship upon which these eclipses might be perfectly well observed. They are by no means in this respect like occultations and transits, with regard to which the *Nautical Almanac* goes on very truly to remark. "The instruments required to observe them with anything like precision will preclude the possibility of their ever becoming available at sea;" and therefore to say that they are, *per se*, of "*no* navigational value," is I think, to use a delicate expression, a little exaggeration. That they are valueless *at present* arises from the fact that the predicted Greenwich times of their occurrence are so inaccurate. Looking over a volume of the Greenwich Observations with my friend, the Astronomer Royal, we found, if my memory serves me, more than one instance of Satellite being at least nineteen seconds wrong; and an error of these dimensions would lead to some very funny map making indeed, to say nothing of landing ships on reefs—*et id genus omne.*

I admire the *Nautical Almanac*, I think, quite as much as Mr. Walker himself; but I do not therefore think it perfect, nor conceive that the interests of science will be best served by placing it on a pedestal, and falling down straightway before its image. What defence of its present condition, jesting remarks penned by Professor de Morgan in 1836 constitute I fail to see. If we only carry out your correspondent's principles in

their integrity, we may well look forward to bequeathing our national ephemeris intact (blunders and all) to our great-grandchildren. I trust, for the sake of English Astronomy, that a less conservative spirit will prevail. Much as I value the privilege of the acquaintance of "Mr. Micawber," I confess my utter want of faith in his theory of waiting "for something to turn up."

I have the honour to be, Sir,

Your obedient servant,

Forest Lodge, Maresfield, Sussex. WILLIAM NOBLE.

August 9, 1871.

THE NEXT TOTAL SOLAR ECLIPSE.

To the Editor of the *Times.*

SIR,—On the occasion of the eclipse of the sun in December last there were frequent inquiries as to the date of the next solar eclipse which will be total in England. I am not aware that any one was in a position at that time to reply to these queries. It was known from the calculations of Hallaschka and others that during the present century there could be no such eclipse, but with the exception of one or two dates in the ensuing century which had been vaguely assigned, and which have proved to be erroneous, I believe no attempt has been made to ascertain this date, or, at least, that no results of the attempt have been published. The uncertainty thus attaching to the subject, though one of mere curiosity to the present generation, has induced me to undertake a systematic and careful examination of future eclipses with the immediate object of discovering the one in question, and I now forward you the principal results. In this inquiry I have examined accurately many eclipses, in which the central line has not eventually been found to pass over this country, it being very difficult in certain cases to determine, without a rigorous computation, how the tracts would run. For the sake of brevity I shall here allude only to two or three such eclipses.

During the first half of the 20th century I have not found the phenomenon of which I was in search. The eclipses in which the central line approaches nearest to our shores are the following:—That of August 30th, 1905, when entering Spain, near Corunna, and passing over Madrid it launches into the Mediterranean, at Valencia; that of August 21st, 1914, when, meeting the coast of Norway in latitude 64½ degrees, and traversing Nykoping, south of Stockholm, it arrives on Prussian territory, at Memel, whence its course is over the south-west of Russia; that of February 3rd, 1916, which will end at sea, 9½ degrees west of Greenwich, and latitude 49½ degrees; and that of 1925, January 24th, passing off near the Faro Isles. On the 30th June, 1954, indeed, there will occur an eclipse, wherein the zone of totality just touches the British islands; it includes the northernmost of the Shetland group. At the northern extremity of the island of Unst I find the last ray of sunlight disappears at about 0h. 23m. p.m. local time, and the total eclipse continues 2m. 20s. This eclipse of June 30th, 1954, is consequently the first in which totality can be witnessed in any part of the British islands, but to discover an eclipse that will be total in England I have found it necessary to continue the calculations to nearly the close of the same century. Such an eclipse (according to my investigation) will not occur until the 11th of August, 1999, when the circumstances will be nearly as follows:—The central and total eclipse will enter upon the

earth's surface in the southern part of the Gulf of Mexico; thence traversing the Atlantic, it meets the English coast at Padstow, in Cornwall, and crossing the south of Devon enters the Channel at Torquay (which will be the most favourable place for observation in this country), and passing over the Eddystone, reaches France about 15 miles east of Dieppe. It will be central and total, with the sun on the meridian some 25 miles south-west of Pesth, and traversing Asia Minor, Persia (at Ispahan), &c., will finally leave the earth's surface in the Bay of Bengal. At Torquay the first contact of limbs or commencement of the eclipse occurs at 8.23 a.m., local mean time, and the last contact at 11.20 a.m. Totality begins at 10h. 0m. 43s., with the sun at an altitude of 48 degrees, and continues 2m. 4s. At Plymouth the duration of total eclipse is 1m. 58s., at Weymouth 1m. 55s. The southern part of the Isle of Wight falls within the northern limit of totality according to my calculation.

The last total solar eclipse, visible in London, occurred on the 3rd of May 1715, and was successfully observed in the metropolis and at many other English stations. In drawing the attention of the Royal Society to this eclipse, Dr. Halley mentioned that since the 20th of March, 1140, he could not find any one that had passed over London, though in the meantime the moon's shadow had frequently crossed other parts of the country. The natural inference from this remark has been that the eclipse of 1140 was total in London, though Halley does not state whether he was guided by historical authority, or by a calculation of the circumstances from the solar and lunar tables. The eclipse is recorded by William of Malmesbury: "While persons were sitting at their meals the darkness became so great that they feared the antient chaos was about to return, and upon going out immediately they perceived several stars about the sun." The Saxon chronicle refers to it in similar terms. I have calculated the particulars of this eclipse, introducing the last value of the secular acceleration of the moon's mean motion, so that my results should very closely represent the circumstances of the phenomenon as it actually occurred. I find the eclipse was not total in London. The central line entered our island at Aberystwith, and passing near Shrewsbury, Stafford, Derby, Nottingham, and Lincoln, reached the German Ocean ten miles south of Saltfleet. The northern limit of the total eclipse passed near Holyhead, Bradford, Leeds, and York, and left England between Filey and Flamborough Head. The southern limit met the coast of Glamorgan below Swansea, and passed over Monmouth, Northampton, Huntingdon, and Norwich: consequently, the nearest approach of the total phase to London was at a point on the borders of Northamptonshire and Bedfordshire. By a special calculation for a point near Stafford, about the centre of the path across England, I find the total eclipse began at 2.36 p.m., local mean time, and that the sun was hidden 3m. 26s., while at an altitude of more than 30 degrees.

The "stars about the sun," remarked by our forefathers, were probably the planets Mercury and Venus, then within a degree from each other, and 10 degrees west of the sun, and possibly the bright stars in the constellations Pegasus and Adromeda, forming what is frequently called, "the square of Pegasus. Mars and Saturn were also at that time within a degree from each other, but very near the western horizon.

It is therefore necessary to look further back than the year 1140 for the total solar eclipse in London next preceding that of 1715. I greatly doubt if, excepting the eclipse of August 11th, 1999, described above, there can be any total solar eclipse visible in England for 250 years from the present time. I am, Sir, your most obedient servant,

Mr. Bishop's Observatory, Twickenham. J. R. HIND.

METEORS.

Dear Sir,—Last evening (Thursday), between the hours of nine and ten, whilst watching the stars with a few friends, we were astonished by seeing no less than 42 falling stars. the majority of which were of considerable size and brilliancy, leaving behind them a trail of light visible some seconds after the disappearance of the star. They nearly all travelled in a southern direction, and started between Cygnus and Hercules. At 10.15 a most brilliant meteor of intense blue colour started from the star γ in Ursa Major, and travelled very slowly till it reached Arcturus, when it suddenly disappeared. The sky was lit up to such a degree that we could see the stars only faintly. At 11.30, a lady friend saw another similar one, which started from the direction of the Dolphin, and travelled to Capricornus. I should be glad to know if these meteors have been noticed elsewhere. The weather the last few days has been most oppressive, and this may account in some way, I suppose, for the appearance of these meteors.

I am, dear Sir, yours obediently,

Pen-y-maes, Hay, S. Wales. HENRY COX.

Several observers have noted a large number of August meteors, which have been this year of considerable frequency and brightness.

DOUBLE STARS.

Sir,—I have the pleasure to send you the results of some recent measures of double stars, in the hope that they may be of interest to some of your readers. The measures were taken with a filar micrometer, attached to my 7¼ inch Alvan Clark Refractor. The column headed N gives the number of nights on which the observations were made.

Star's Name.	Angle of Pos.	Distance.	N.	Epoch.
γ Leonis	112°·82	3″·033	3	1871·38
γ Virginis	159°·79	4″·492	3	1871·38
Σ 1785 (Boötis) ...	199°·23	2″·544	3	1871·38
η Coronæ Bor. ...	45°·85	1″·003	5	1871·54
σ Coronæ Bor. ...	195°·34	3″·228	4	1871·53
ζ Herculis	183°·33	1″·021	5	1871·54
Σ 2120 (Herculis)	263°·33	3″·866	3	1871·51
δ Herculis	180°·27	19″·332	3	1871·60
70 Ophiuchi ...	94°·92	4″·301	3	1871·59
61 Cygni	113°·44	19″·167	3	1871·60
ζ Aquarii	333°·61	3″·348	3	1871·61

γ. *Leonis.* Colours, "A," full clear yellow. "B," cool grey green. The decided green tint of "B" always strikes me as peculiar.

γ. *Virginis.* Although I have taken the northern star as my "A," it appears to me rather the less of the two, and of a rather deeper yellow.

Σ. 1785. A binary. The angle increasing—the distance decreasing.

η. *Coronæ Bor.* The distance is, I believe, now decreasing.

σ. *Coronæ Bor.* I have noted the colours of the components—white or very pale yellow, and clear sky-blue.

ζ. *Herculis.* The distance was measured on four nights only. The colour of "B," to my eye, is a full deep orange, with almost a brown cast. But for the depth of tint, the measurements would present more difficulty with my aperture, as the small star falls on the first bright ring of the primary.

Σ. 2120. A binary apparently. Mags. "A" 7, "B" 10. The tint of "A" is peculiar. I have noted it "tawny" "or "*pale yellow with rosy flush.*" The colour of "B" is a fine deep clear blue.

δ. *Herculis.* Colours pale yellow, and ruddy purple.

70 *Ophinchi.* Colours pale yellow, and ruddy lilac.

61 *Cygni.* Both stars orange yellow, the smaller rather deeper in tint than the larger.

I am, Sir, yours faithfully,
GEORGE KNOTT.

Woodcroft Observatory, Cuckfield:
August 16, 1871.

THE GREAT NEBULA OF ETA ARGUS.

Continued from No. 104, page 195.

It is not surprising, then, that Mr. Powell, who appears to have been the first to notice change in the nebula attributed it to his comparatively small telescope, and did not then publish his observations. Amongst his photometric observations of Eta are found the notes about the nebula. "March 23, 1860, nebula about Eta Argus magnificent;" "April 15, 1860, nebula much fainter than formerly;" "March 23, 1860, again, Eta is in a rough sketch placed outside the bright portion of the nebula." And the lemniscate is described as a *channel.* Several entries follow, noting openness of the lemniscate on the south, and greatly diminished brightness of the nebula. "April 4, 1862, Eta Argus beautifully round and clear out of the lemniscate altogether; two patches of nebula with passage between them to the left or preceding."

These were not published till May, 1864 (R.A.S. Notices), after Mr. Abbott had published his observations; to Mr. Abbott is therefore due the credit of first publishing notice of a change in the appearance of the nebula. He had been observing the star for a number of years; but the first observation on the nebula that I can find is dated May 23rd, 1863, and runs thus: "A drawing made of the object Eta Argus quite distinct within the dark space." This was given to the Royal Society of Tasmania on the 9th June, 1863, in a paper on the "Variable star Eta Argus."

A further remark occurs in that paper to this effect: "Comparing the present description with the Cape drawing, it will, I think, appear conclusive that the apparition of the surrounding nebula is also variable. The open space given in the Cape Monograph, and also in the last edition of the outlines, is somewhat in the form of a dumb-bell compressed in the centre, and surrounded with nebula, in the most dense part of which is situated Eta Argus. The appearance of the open space now assumes the form of a crooked billet, wide in the centre and open at both ends, with Eta Argus situated 1′+ within the open space or dark part, and surrounded with an almost innumerable quantity of brilliant stars, some of a blue and some of a ruddy colour."

In May, 1868, some additional observations and a drawing by Mr. Abbott were published in the R. A. S. Notices. Sir John Herschel was very much interested, and carefully compared the drawing with his own in every possible way; he could not, however, identify any of the stars, and could make nothing of the drawing.

In R. A. S. Notices for 1868, he remarks:—"It is much to be wished that some southern observer, furnished with an equatorially mounted telescope, would without further delay set to work and map down the stars visible within this most interesting area, down, at least, to the tenth or eleventh magnitude. Possibly, I may have done Mr. Abbott injustice by assuming that his diagram is intended to convey any delineation at all of the stellar contents of his fields of view; or anything beyond the forms of the nebulous masses as existing among scattered stars. But the question once raised is of the last importance, and must be settled. The question here is not one of minute variations in subordinate features, which may, or may not be attributable to differences of optical power in the instruments used by different observers, as in the case with the nebula in Orion (the only one at all comparable with it in magnitude, complexity, and brightness), but of a total change of form and character—a complete subversion of all the greatest and most striking features, which reminds us more of the capricious changes of form and place of a cloud drifted by the wind, than of anything before witnessed in the sidereal heavens."

In August of the same year Lieutenant Herschel, having gone out to India in charge of one of the Eclipse expeditions, took the opportunity of observing Eta Argus nebula. At his father's request fifty of the principal stars were measured, and identified with stars in the Cape Monograph without difficulty; and several drawings were made of the nebula, showing an enclosed space near Eta, and other features much more like the Cape drawing than Mr. Abbott's. He remarked, also, the increased visibility of the nebula, but said there did not appear to be any very remarkable change in the distribution of the stars or nebula so far as the part immediately around Eta is concerned. R. A. S. Notices for 1869.

In 1869 Mr. Le Seur turned the large Melbourne reflector upon this nebula, and with the speculum, as it then was, could not recognise any nebula immediately round Eta, which was consequently thought to be in the dark space. I have not seen his drawing, and cannot, therefore, say what features he noted; before he left he repolished the speculum, and the telescope now performs much better. With it Mr. M'George has been able to see that Eta is still in the nebula; and in his drawing, which includes only the nebulous mass in which the lemniscate is situated, shows the very dense part near and north of Eta, the enclosed space, and some remarkable minor details at a point about 17 s. preceding and 80″ north of Eta, which are changing rapidly.

It thus appears that, up to the end of 1870, no one had complied with Sir John Herschel's request, but that all the observers had confined their drawings to the nebulous mass in which the lemniscate is situated, and neglected the branches. My first intention was to do the same, for the difficulty of representing such a complicated nebula is very considerable, but I noticed such changes in the branches that I was induced to examine carefully all that is included in the Cape drawing, and to attempt to represent greater part of it.

I determined last year to examine this object, believing that when such a subject is under discussion, all who have the means of furnishing information should do so, and because the Sydney refractor is in defining and light-gathering power nearer to the reflector with which the Cape

drawing was made, than any which has since been directed to the object.

From many trials on close double stars I find this instrument quite equal in defining power to the eighteen-inch reflector, but of course not equal to it for revealing minute stars.

Unfortunately in August last Eta Argus was too low down to admit of any satisfactory observations, and I was obliged to defer it to January this year; when I took every favourable opportunity of observing it, and completed the drawing early in March. The observations were taken after the object had attained an altitude of 50° up to 64°.

"Of the 108 stars in my list I was able to identify 104 with those in the Cape list; of the remaining 4—one, No. 25, is very small, and forms part of a triangle close to Eta. In 1834-8 it was probably hidden by the light of Eta. Another, No. 32, is in the dark enclosure, and very small indeed, I am inclined to think it is variable, from comparisons made with four faint ones near Eta. Another, No. 68, must, I think, have appeared since 1834-8, for it is now a conspicuous star, about tenth magnitude, and I am convinced could not have escaped Sir John Herschel's wonderfully accurate survey; and the fourth, No. 92, I have since found is No. 142 H, an error of 10 s. having occurred in recording the right ascension, which should be 135 s. instead of 145 s.

"Of the magnitudes of stars, it is beyond doubt that several of those in the Cape list have changed, and are therefore variable as well as Eta. Mr. Abbott speaks of change but gives no particulars. Lieutenant Herschel also remarked it, but has not given particulars. Mr. Tebbut, whose accurate observations since 1854 on Eta enabled Professor Loomis to correct the period of its variation, noted change in some of the stars in 1868, and, in the recent communication to the R. A. S., notes particularly the changes I have remarked in the largest stars, neither of us being at the time aware of the other's results.

"In 1834-8 No. 71 was sixth magnitude, No. 72 seventh magnitude; now No. 72 is fully half a magnitude larger than No. 71, so that at least one must have changed, and it is remarkable also that the nebula has almost faded from these two stars, as from Eta. No. 105 was sixth magnitude, and No. 101 seventh magnitude; now both are seventh magnitude, and equal to No. 71. Yet all these stars are much brighter than the other seventh magnitude stars of the Cape list, viz., Nos. 1, 2, 291, 300, 51 R=403, 59 R=844, and 1215. I would not, however, lay too much stress upon this until it is known whether all the seventh magnitudes in the Cape list were equal, for, if not, it may be that only Nos. 71 and 105 have changed.

"As to the colours of the stars near Eta, they are, in my estimation, pale indeed compared with κ Crucis; and if in 1865 bright enough to merit Mr. Abbott's remark, 'that although Sir John Hirschel has not overdrawn the beauty of κ Crux, the object Eta Argus is much more superb,' they must have faded wonderfully since, for I only remarked colour in two beside Eta, and both were red. Dr. Wright, who has examined both objects with an 8½-inch Browning reflector, failed to detect anything striking in those near Eta. I have measured several of the double stars, and have not yet found any evidence of angular motion. During my first evening's observation I carefully measured the differences in R.A. and declination of 54 stars from Eta. With a fine parallel wire micrometer, a sheet of paper four times the size of the Cape drawing was taken, and lines drawn on it to the same angular scale; but twice the distance apart upon this, the 54 measured stars were carefully laid down, and the drawing of the nebula then proceeded with. The sheet was kept on a desk near the telescope, and as each outline was traced with the

telescope amongst the measured stars, it was laid down on the sheet. When in order to define the positions of particular parts other stars were required, these were measured and the drawing proceeded with. The bright wires on a dark field of the micrometer were also found very useful in guiding the eye, and in three places used to measure the distance of the definite parts from Eta."

IS THE WORLD ROUND OR FLAT?—A SCIENTIFIC WAGER.

SECONDARIES' COURT, GUILDHALL, JULY 27.

(*Before Mr.* KERR).

WALLACE V. HAMPDEN.

This action arising out of a scientific wager, between John Hampden and Alfred Russell Wallace, as to whether the earth is "round or flat," was decided this morning.

Mr. Edward Clarke (barrister) applied under a writ of inquiry for damages issued in this cause, consequent upon judgment going by default against John Hampden. The learned counsel, in a lucid statement, explained that an action which had been brought by Mr. Wallace against Mr. Hampden, for a gross libel that had been published and circulated by the defendant, had been suffered to go by default, and that the plaintiff in consequence sought the damages he was entitled to. Mr. Wallace, he said, was a gentleman of high reputation, and was a member of several learned and scientific societies. He became acquainted with the defendant at the end of last year, through a challenge that he published, offering to stake £500 against £500 of any other scientific man, and to prove that the world was a flat body and not round, as was generally believed to be the case. Finding that some time elapsed before his challenge was noticed, he went further, and stated that scientific men knew they were guilty of an imposition in propounding the *round* theory, and that they were in consequence afraid to take up the challenge. Mr. Wallace subsequently answered the challenge, and lodged his £500 with that of Mr. Hampden's, at Coutts's Bank, to be drawn out and handed over to the party in whose favour the arbitrators decided after the proposed experiments had been gone through. The defendant proposed that the experiments should take place at the Bedford Level. Mr. Wallace was quite content, and the trial was accordingly proceeded with. It was very simple. There were three long staves of equal length. One was placed on the Bedford Canal, another was placed at a distance of three miles, and the third also at the same distance. A telescope was employed, through which it was clearly and unmistakeably perceived that the centre stave was five feet above the line of the telescope, which at once proved that the water was not flat, but oval. Mr. Hampden accordingly expressed himself satisfied, and the money was paid over to Mr. Wallace by Mr. Walsh, of the *Field* newspaper, who had stood as referee. Some time after this Hampden issued a publication of his own, in which he denounced Mr. Wallace as a "liar," a "swindler," and everything that was bad, persisting at the same time that his (Mr. Hampden's) was the correct theory. The libels, which were of the grossest nature, were aggravated by the defendant asserting that Mr. Wallace was afraid to go into court. Mr. Wallace had been eminently forbearing, but,

owing to the persistence of Mr. Hampden, was compelled to take the present steps for his protection.

Mr. Wallace was called, and stated that he had experienced a great deal of annoyance in consequence of Mr. Hampden's conduct; and the jury, after a short deliberation, found a verdict of £600 for the plaintiff.

NEW PLANET.—Professor C. H. F. Peters, of the Lichfield Observatory, Hamilton College, announces the discovery of a small planet, the 114th in the group of asteroids, at 3 a.m. on the 25th of July. It was observed in 21 hours 43 minutes right declension, and 10 degrees 12 minutes south declension, having moved in 24 hours 45 seconds in the former co-ordinate, and 4 minutes and 20 seconds toward the south. Its magnitude is estimated between 12 and 13.

THE AUGUST METEORS.—On Thursday night (Aug. 10th) it was expected that there would be a display of meteors. At midnight the heavens were uniformly dark, and there was no moon visible, but the meteors did not appear. The August meteors, though almost forgotten during the past few years through the attention which has been bestowed upon the November showers, are famous among observers of meteoric astronomy. Professor Alexander Herschel, son of Sir John Herschel, made a discovery in 1866, respecting the August meteors, which serves yet further to enhance the interest of the display. Studying them with a spectroscope, he found that some of them are evaporised during their flight through our air, and that they consist in large part of the vapour of sodium, the chief element of our common salt and soda. Many of the meteors, he tells us, "are nothing else but soda flames, for a great proportion (that is to say, the latter portion) of the time they continue visible." Their condition is then exactly that of the flame of a spirit-lamp, newly-trimmed and largely dosed with a supply of moistened salt; a strange fact truly, and to be had in remembrance as we watch the streaks left by the meteors slowly fading from view. Those soda-flames scarcely accord, perhaps, with our ideas of favourable conditions under which seed-bearing meteorites might plant life, either on our own or on other worlds. Yet ideas scarcely less strange are suggested by the consideration of what must needs happen with the vaporised sodium. As it cools, the vapour becomes sodium dust, and as such it sinks through the air and falls in the lightest of showers on land and sea. For countless ages this has happened. Not the August meteors alone, but upwards of a hundred meteor systems (for so many have been recognised by Heis and Alexander Herschel) have poured their tribute of matter (not sodium alone) from outer space upon this globe, not only during the period of man's existence, but doubtless for ages before he appeared upon the earth. If we have not here the seeds of life conveyed to the earth from interplanetary and interstellar space, we have a supply of many materials which help to support life. So that not only may man, as Humboldt remarked, actually touch (in the aerolite) a non-telluric mass which has for ages traversed space, but he may utilise in his daily work, and even consume in his daily food, the substance of bodies which once travelled beyond the most distant planets, or even circled for ages around other suns than ours.—*Scotsman.*

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN SEPTEMBER, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight.		Objects to be observed.
	°	′	
17	138	51·1	Picard, A and B Mare Crisium.
18	125	43·7	Fabricius (*a*), Mesius, Steinheil.
19*	112	34·2	Theophilus (*b*). Cyrillius, Catharina.
20	99	24·9	Ariadæus, Silberschlag, Hyginus (*c*).
21†	86	17·1	Mare Serenitatis (*d*), Sulpicius, Gallus.
22	73	11·5	Herschel I. (*e*), and region to the N.
23	60	9·1	Parry, Boupland, Fra Mauro.
24	47	11·0	Plato, the Hartwell ledge (*f*).
25	34	19·3	Furrow from Tycho to Bullialdus.
26	21	36·6	Hippalus craters on the interior.
27	9	5 7	Three bright craters W. of Hipparchus.
28‡	—3	10·5	Lapeyrouse, Ansgarius, Behaim.
29	—15	10·0	Langrenus, Vendelinus, Petavius.
30	26	52·1	Fabricius, Janssen, Metius.

For additional objects consult the lists for May and July.

* Summer solstice, N. hemisphere.

† On the 20th and 21st the disc differs but little from a state of mean libration.

‡ Evening terminator.—The objects specified on the 28th, 29th and 30th are seen under the evening illumination.

(*a*) On the S. of Fabricius is a large depression with an elongated central elevation, which stretches from the S. border of Fabricius. It is proposed to name it Janssen.

(*b*) The passage of the morning terminator has lately been favourable for observing sunrise on Theophilus, on May 24th, 1871, the illumination of the two central peaks was well observed.

(*c*) Observations of the great cleft from the E. of Hyginus into the Mare Tranquillitatis are much wanted.

(*d*) Attention is solicited to the three craters N.W. of Linné. Occasionally they are not visible. This was the case on May 26th, 1871, 8·50 to 9·50. Notices of the appearance of surrounding objects are at the same time important.

(*e*) The Rev. T. W. Webb calls attention to a remarkable valley on the N.W. of Herschel I., which is just N. of Ptolemæus. It appears as if *scooped* out by a force not of an eruptive character.

(*f*) A fine delicate hue of light fringing the S.W. border of Plato, visible for about 48 hours.

Errata in No. 104, p. 182, line 15 from the bottom, for *Radamba*, read *Kadamba*. Page 179, line 12 from the end, for *clock seconds*, read *minutes*. Page 183, line 11 from the bottom, for *error*, read *once*. Line 10 from the bottom, for *Associate* read *Asiatic*. Page 186, line 7 from the bottom, for *Vitane* read *Vita e*. Page 194, line 28, for *Aldebran and Leonis*, read *Aldebaran and alpha Leonis*.

New Comet.—Just as we were going to press with our last issue, tidings reached England of the discovery of a New Comet by M. Schiaparelli, at Mailand. It is described as an object of extreme faintness. The following elements are by M. Rumker, of Hamburg.

T	=	1871	Aug. 1·87.
π	=	104	28
Ω	=	209	5
ι	=	79	45
log. q	=	0·00852	

Motion, Retrograde.

During the whole of July it only moved through one hour of R.A., and one degree of Declination. On July 30th, its R.A. was 8h. 49·2m. and $\delta + 59^\circ\ 2'$.

ENCKE'S COMET, 1871.

M. Glasenapp, of Pulkowa, has computed the following ephemeris for Encke's comet, now returning to our parts of space.

1871.		R.A. h. m. s.		Decl. ° ′
Sept. 1	...	2 7 29	...	+26 14
2	...	2 7 33	...	26 26
3	...	2 7 33	...	26 39
4	...	2 7 32	...	26 52
5	...	2 7 28	...	27 5
6	...	2 7 22	...	27 17
7	...	2 7 13	...	27 31
8	...	2 7 1	...	27 44
9	...	2 6 46	...	27 57
10	...	2 6 28	...	28 11
11	...	2 6 8	...	28 25
12	...	2 5 44	...	28 39
13	...	2 5 16	...	28 53
14	...	2 4 45	...	29 7
15	...	2 4 10	...	29 21
16	...	2 3 31	...	29 36
17	...	2 2 49	...	29 51
18	...	2 2 2	...	30 6
19	...	2 1 10	...	30 21
20	...	2 0 14	...	30 36
21	...	1 59 13	...	30 52
22	...	1 58 8	...	31 7
23	...	1 56 56	...	31 23
24	...	1 55 39	...	31 39
25	...	1 54 17	...	31 56
26	...	1 52 48	...	32 12
27	...	1 51 13	...	32 29
28	...	1 49 31	...	32 46
29	...	1 47 42	...	32 3
30	...	1 45 45	...	+32 20

OBSERVATIONS FOR SEPTEMBER, 1871.*

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, midnight	60°N.	0°	60°S.
	Sunset.		
	°	°	°
1871. Sept. 1	+64·0	+61·5	+58·9
2	51·8	49·3	46·7
3	39·7	37·1	34·5
4	27·5	24·9	22·3
5	15·3	12·7	+10·1
6	+3·1	+0·5	−2·1
7	−9·1	−11·7	−14·3
8	21·3	23·9	26·5
9	33·5	36·1	38·8
10	45·7	48·4	51·0
11	58·0	60·6	63·2
12	−70·2	−72·8	−75·5
	Sunrise.		
16	+55·6	+58·3	+60·9
17	43·4	46·0	48·7
18	31·1	33·8	36·5
19	18·9	21·6	24·3
20	+6·7	+9·4	+12·0
21	−5·5	−2·8	−0·1
22	17·7	15·0	12·3
23	29·8	27·2	24·5
24	42·0	39·4	36·7
25	54·2	51·5	48·9
26	66·3	63·7	61·1
27	−78·5	−75·9	−73·2
	Sunset.		
29	+82·4	+79·8	+77·2
30	+70·2	+67·6	+63·0

* The computer regrets that the table, p. 199, for August is affected by a constant error (the amount of the moon's rotation for one day). To get the correct valuer, +13·2 must be added to all the longitudes there given.

ASTRONOMICAL OCCURRENCES FOR SEPTEMBER, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn
Fri	1		Sidereal Time at Mean Noon, 10h. 40m. 50s.			7 32·2
Sat	2		Meridian Passage of the Sun, 0m. 21·17s. before Mean Noon	2nd Sh. I.	15 51	7 28·3
Sun	3	13 56	Near approach of B.A.C. 830 (6)			7 24·3
Mon	4			4th Tr. E. 2nd Oc. R. 1st Ec. D.	14 53 15 5 15 38 53	7 20·3
Tues	5			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	12 46 13 47 15 5 16 6	7 16·4
Wed	6	10 9	☾ Moon's Last Quarter	1st Oc. R.	13 25	7 12·4
Thur	7	16 18 17 18	Occultation of 1 Geminorum (5) Reappearance of ditto			7 8·5
Fri	8	14 2 14 40	Occultation of B. A. C. 2238 (6) Reappearance of ditto			7 4·6
Sat	9	17 13	Conjunction of Moon and Jupiter, 2° 6′ S.	3rd Oc. D. 3rd Oc. R.	13 23 16 44	7 0·7
Sun	10	5 52	Conjunction of Moon and Uranus, 2° 12′ S.			6 56·8
Mon	11			2nd Ec. D.	12 47 34	6 52·9
Tues	12			4th Ec. R. 1st Sh. I. 1st Tr. I. 1st Sh. E.	14 39 20 14 40 15 45 16 58	6 49·0
Wed	13			2nd Tr. E. 1st Oc. R.	12 49 15 23	6 45·1
Thur	14	7 9 10 49	● New Moon Conjunction of Moon and Mercury, 9° 30′ S.	1st Tr. E.	12 34	6 41·2
Fri	15	0 39	Conjunction of Moon and Venus, 14° 27′ S. Illuminated portion of disc of Venus=0·041 ,, Mars=0·901			6 37·3

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	16		Sidereal Time at Mean Noon, 11h. 39m. 58·30s. Meridian Passage of the Sun, 5m. 6·13s. before Mean Noon	3rd Ec. D. 3rd Ec. R. 3rd Oc. D.	13 12 2 16 18 2 17 39	6 33·4
Sun	17	6 53 6 10	Occultation of κ Virginis ($4\frac{1}{2}$) Inferior Conjunction of Mercury			6 29·6
Mon	18	18 9	Conjunction of Moon and Mars, 3° 54′ S.	2nd Ec. D.	15 23 47	6 25·7
Tues	19	7 44 7 44	Occultation of β 1 Scorpii (2) Occultation of B. A. C., 5330 ($5\frac{1}{2}$) Saturn's Ring: Major Axis=38·01″ Minor Axis=16·94″	1st Sh. I. 1st Tr. I.	16 34 17 43	6 21·9
Wed	20	5 12	☽ Moon's First Quarter	2nd Tr. I. 2nd Sh. E. 1st Ec. D. 2nd Tr. E. 1st Oc. R.	12 38 13 7 13 53 58 15 31 17 20	Moon. — 4 54·4
Thur	21	6 14 13 58	Near approach of 7 Sagittarii (6) Conjunction of Moon and Saturn, 1° 14′ N.	1st Tr I. 1st Sh. E. 1st Tr. E.	12 13 13 21 14 32	5 53·5
Fri	22			1st Oc. R.	11 49	6 53·8
Sat	23			3rd Ec. D.	17 10 46	7 53·8
Sun	24	6 35 7 50 10 37 11 46	Occultation of χ Capricorni (6) Reappearance of ditto Occultation of ϕ Capricorni ($5\frac{1}{2}$) Reappearance of ditto			8 51·1
Mon	25	23 3	Inferior Conjunction of Venus			9 45·4
Tues	26					10 36·4
Wed	27	14 36 15 23 16 52	Occultation of 30 Piscium (5) Reappearance of ditto Near approach of 33 Piscium (5)	3rd Tr. I. 2nd Sh I. 3rd Tr. E. 2nd Tr. I. 2nd Sh. E. 1st Ec. D.	11 52 12 49 15 16 15 18 15 41 15 47 13	11 24·4
Thur	28	5 44	○ Full Moon	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	12 57 14 10 15 15 16 29	12 10·2
Fri	29	17 3 17 58	Occultation of Piscium ($4\frac{1}{2}$) Reappearance of ditto	2nd Oc. R. 1st Oc. R. 4th Oc. D.	12 41 13 45 17 9	12 54·8
Sat	30					13 39·0

THE PLANETS FOR SEPTEMBER.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	12 3 33	—4 38	8″·6	1 22·5
	15th	11 42 24	2 1½	10″·4	{ 0 6·3 { 23 59·0
Venus ...	1st	12 28 40	—9 57½	45″·5	1 47·5
	15th	12 18 59	11 4	56″·9	0 42·8
Jupiter ...	17th	7 46 34	+21 19½	32″·8	19 59·4
Saturn ...	1st	18 14 18	—22 47	15″·6	7 32·2
	15th	18 14 25	22 49	15″·4	6 37·3
Neptune ...	2nd	1 30 26	+7 36	...	14 43·2
	14th	1 29 31	+7 30	...	13 55·1

Mercury is near the sun, setting before it till the 9th, on which day they will set together; towards the end of the month the planet will rise about an hour and a half before the sun.

Venus sets a short time before the sun till the 7th, and will be visible as a morning star towards the end of the month.

Jupiter for the first half of the month is a morning star, rising in the early morning; after the 17th he will rise before midnight and be visible during the rest of the night.

Saturn is excellently situated for observation, setting at the beginning of the month, four hours and a half after sunset, the interval decreasing to four hours at the end of the month.

SUN.

Greenwich Noon. 1871.		Heliographical longitude of the apparent centre of the sun's disc.			Heliographical latitude		Angle of position of the sun's axis.
		°			°		°
Sept. 1	...	89·07	—122 δ ξ	...	+7·22 N.	...	21·31
2	...	102·29	—121	...	·23	...	21·56
3	...	115·52	—120 δ ξ	...	+7·24	...	21·81
4	...	128·74	—119	...	·24	...	22·05
5	...	141·96	—118	...	·25	...	22·28
6	...	155·18	—117	...	·25	...	22·51
7	...	168·41	—116	...	·25	...	22·74
8	...	181·63	—115	...	·25	...	22·95
9	...	194·85	—114	...	·24	...	23·16
10	...	208·07	—113 δ ξ	...	+7·24	...	23·37
11	...	221·28	—112	...	·23	...	23·57
12	...	234·50	—111	...	·22	...	23·76
13	...	247·72	—110	...	·21	...	23·95
14	...	260·94	—109	...	·19	...	24·13

15	...	274·15	—108	...	·17	... 24·30
16	...	287·37	—107	..	·15	... 24·47
17	...	300·59	—106 $\delta\xi$	...	+7·13	... 24·64
18	...	313·80	—105	...	·11	... 24·79
19	...	327·02	—104	...	·09	... 24·94
20	...	340·23	—103	...	·06	... 25·08
21	...	353·45	—102	...	·03	... 25·22
22	...	6·66	—101	...	7·00	... 25·35
23	...	19·87	—100	...	6·97	... 25·47
24	...	33·09	—99 $\delta\xi$	...	+6·93	... 25·59
25	...	46·30	—98	...	6·89	... 25·70
26	...	59·51	—97	...	6·85	... 25·80
27	...	72·73	—96	...	6·81	... 25·90
28	...	85·94	—95	...	6·77	... 25·99
29	...	99·15	—94	...	6·72	... 26·07
30	...	112·36	—93	...	6·67	... 26·14
Oct. 1	...	125·57	—92 $\delta\xi$	...	+6·62N.	... 26·21

The heliographical longitudes here given are western longitudes, reckoned from an arbitrary first meridian, which is assumed to be directed to the first point of Aries, on January 1st, 1872, and to rotate at the daily rate of $14°·2 + \delta\xi$ ($14°·2$ being about the average rate of rotation of the spots). The position of the sun's equator is assumed in accordance with Carrington's final determination (*Solar Spots*, p. 244), namely,

Inclination ... 7° 15′ } in reference to the
Node ... ... 73 40 } eclipse of 1850.

VARIABLE STARS.

According to data published by Professors Schoenfeld and Winnecke, the following maxima and minima may be observed during September.

1871.	G. M. T. h m.					A. R. h. m. s. (Place of Star for 1855)	Decl. ° ′
Sept. 2	11 8	Algol ...	min.				
5	8 6	Algol ...	—				
7		S Aquilæ ...	—	11	...	20 4 57	+15 11·5
—		R Canis ...	min.	10	...	7 0 44	+10 15·0
8		S Vulpeculæ	max.	8·7	...	19 42 27	+26 55·7
11	13 0	U Coronæ ...	min.	9	...	15 12 17	+32 10·8
13		R Sagittarii	max.	7	...	19 8 11	—19 33·5
14		S Cassiopeæ...	—	7·5	...	1 9 4	+71 50·8
18	10 7	U Coronæ ...	min.	9			
19		S Cygni ...	max.	8·8	...	20 2 28	+57 34·2
—	16 6	Algol ...	min.				
20		U Cancri ...	max.	8·2	...	8 27 28	+19 23·5
22	13 4	Algol ...	min.				
—		R Aurigæ ...	max.	6·6	...	5 5 36	+53 25·0
23		R Ceti ...	—	8·3	...	2 18 38	—0 50·1
24		S Herculis ...	—	6·3	...	16 45 18	+15 11·4
25	8 4	U Coronæ ...	min.	9			
—	10 2	Algol ...	—				
28	7 0	Algol ...	—				
—	15 9	S Cancri ...	—	10·2	...	8 35 39	+19 33·2
29		R Arietis ...	max.	7·5		2 7 53	+24 22·9

Observers of variable stars are requested to watch the changes of magnitude of a new variable in Pegasus, in A. R. 23h. 13 m. 13s. Decl. +8° 7′·5 for 1855. At present it is of about 10m. and is likely soon to increase in brightness, but nothing is yet known of its period.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1871.

Ryley, F. B.

To Sept., 1871.

Linwood, Rev. W.
Woodman, T. C.

To Oct., 1871.

Lewis, H. K.

To Dec., 1871.

Bridson, J. R.
Hubbersty, Rev. R. C.
Lee, G.
Sargent, Rev. J. P.
Vines, D.
Weldon, Mrs.

To June, 1872.

Green, Joseph.

August 21, 1871. Subscriptions after this date in our next.

Instruments, &c., For Sale or Wanted.

These Notices, which must in all cases be paid for in advance, are inserted at the rate of *One Shilling* for *Twenty Words* or under; half-price only will be charged upon repetition, if no alteration is required. When the address is not given, application may be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—The Notice will be withdrawn should the payment not be renewed.

TO CORRESPONDENTS.

We have received a photograph of Mr. W. Cock's £5 Sidereal Clock.

Several Papers are deferred for want of space.

With this number are given the INDEX AND TITLE to the last Volume of the *Register*.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 106. OCTOBER. 1871.

ON THE STUDY OF SELENOGRAPHY.

By W. R. Birt, F.R.A.S.—No. II.

The subject of our first paper being of a preliminary character, and dealing only with the means of obtaining by the help of the two maps mentioned a general acquaintance with the moon's surface, it may be well in this communication to place before the student a few definite objects of research to which his attention may be profitably directed, and through which it is not unlikely he may contribute to the advancement of our knowledge.

Selenological investigation, having for its ultimate object a knowledge of the physical processes which have been, or still are, in continual or occasional operation within the limits of our satellite, the aim of the scientific selenologist should undoubtedly be directed to obtain an acquaintance with these processes. We are not aware that the study of selenography has ever been seriously taken up with this view; the utmost extent to which it has proceeded is that of delineating the surface and describing its topographical features.

The study of selenology is two-fold; it looks backwards and contemplates those selenographical features, which convey to us information of the operation of forces which have *successively* moulded and modified the surface; it takes cognizance of those appearances observed from time to time, which indicate that forces are still in operation on or near the surface producing "change." The detection of change, with an apprehension of the physical processes by which it is occasioned, is at the present time a subject of great interest.

These two lines of research, although presenting many difficulties, especially to such students as these papers are intended for, are, nevertheless, of sufficient importance to induce us to point out the most efficient means of surmounting them. Of the two, the latter, the detection of change, is by far the more difficult. We shall, therefore, offer a few remarks on the study of the first, which has reference to *successive* eras of formation on the moon's surface, occasionally diverging to notice any modes of observation that may assist in advancing the second.

The two maps already referred to will assist but little in these inquiries, as they are intended chiefly as guides to the principal objects. As, however, observations increase, students will find it advantageous to form indexes, in order that particular features may easily be referred to, and their distinguishing characteristics kept before the mind. When all the referenced objects are well identified on both maps, objects without references should be assiduously sought for.

With a view to become acquainted with features that manifest priority and posteriority of formation, the observer will find it useful to sketch such objects as may arrest his attention, carefully recording on each sketch the date, day of Julian period, &c., as already mentioned. Reference is again made to sketching, because a large number of delineations of various parts of the moon's surface exist with which the observer would do well to compare his own sketches. The practice he has obtained in identifying objects will peculiarly fit him for critically examining the drawings of Schröter in the *Selenotopographische Fragmente*, and we should strongly recommend the observer to identify all the objects in these drawings in the same manner as the larger objects on the maps. It appears to be a most essential element in the advancement of selenography that each separate object on the moon's surface, no matter how small, should be regarded as a separate object of study. If a crater, its exact appearance should be delineated and recorded; should it be near the terminator, not only should its interior shadow be shown, but the extent of the shadow recorded in decimal parts of the diameter of the crater. If a mountain, in addition to its general appearance with its shadow in the drawing, a record especially of the direction of the shadow in reference to surrounding objects should be preserved. The bearing of such studies as these on the questions of activity or change is obvious. The absence of a referenced object in Schröter will excite suspicion that change has taken place since his epoch, and should it occur that after long searching it should be again recovered, an explanation of its absence may be afforded by assuming that forces of some kind have been actively operating during the interval.

It will readily be seen that, to carry out these suggestions effectively, both time and labour of no ordinary amount must be given, and, in addition, we ought to have accurate and minute measurements of the diameters of craters and other objects, including measures for position, &c. When we reflect that no measures of importance have been published since Mädler's time, we need not wonder that selenography has fallen far behind other branches of astronomy. Sir William Thomson, in his address to the British Association, says, "accurate and minute measurement seems to the more scientific imagination a less lofty and dignified work than looking for something new, but nearly all the grandest discoveries of science have been but the rewards of accurate measurement and patient long-continued labour in the minute sifting of numerical results." Professor Tait, in his opening address to the Physical Section, exhorts mathematicians to be up and doing. "'A little folding of the hands to sleep,'" in chuckling satisfaction at what has been achieved of late years by our great experimenters, and we shall be left hopelessly behind. The sad fate of Newton's successors ought to be a warning to us. Trusting to what he had done, they allowed mathematical science almost to die out in this country." May we not say that, trusting to what Mädler has done, astronomers, with but few exceptions, have allowed selenography so to decline, that but comparatively little interest is manifested in it at present.

The division of labour appears to be the most legitimate mode of meeting this state of things, while the aspect of affairs is no doubt gloomy, inasmuch as lunar physics are but little thought of in some quarters. We have a small band of devoted selenographers who, by the most patient and unremitting attention, are helping on the work; and, while these observers give the greatest share of their labours to elucidating the question of present activity and its connection with change, there is great room for others, if so disposed, to attack the subject of former activity, the evidences of which are scattered broadcast over the moon's surface.

The establishment of a system of correspondence between selenographers (if published, so much the better) would tend greatly to increase the interest in the general subject; for example, let a formation be chosen for observation of which records exist in Schröter, Lohrmann, Beer, and Mädler, the areas of the British Association map, or the Mare Serenitatis; a comparison of the moon at the telescope with each of the above-named authorities could not fail of producing valuable results; something would be elicited illustrative either of former or present activity; the condition of the same object could be traced from the epoch of Schröter onwards; and, while one or two differences amongst the authorities above-named might be referred to errors of delineation, still, as these supposed errors became numerous, a discussion of them *inter se* might throw such light upon them, as to indicate the high probability of their having been faithful records.

With regard to successive eras of formation, we may remark that a few notices occur in the writings of older selenographers; indeed, the fact is not disputed by modern writers; it is, perhaps, the mode in which it is put by two authorities that attention should be drawn to it. A complete history of all the changes that any given formation has passed through, as evidenced by the mountains, craters, faults, fissures, and markings on and around it, would go far, not only to indicate the nature of the forces that have operated in past selenological time, but would throw light on any possible manifestations of the same forces at the present epoch. To accomplish this, earnest co-operation is essential; this has been afforded, and we hope at no very distant day to present to astronomers such a history, materials having been furnished by selenographers who have steadily and unremittingly observed a well-known formation for some years past.

THE FALLING STARS.*

This year, also, in the night of the 10th August, we have had the usual rain of falling stars, called *Perseids*, because they traverse the heavens in lines which all meet in one point, or *radiant*, in the constellation of Perseus. This rain has, however, been rather limited; since from 9½h. in the evening until 2h. after midnight only 160 falling stars were seen, of which only 26 were moderately large. Only one bolide of considerable size was seen in the night of the 10th—11th August, at 2h. 20m. It started from the centre of the constellation Perseus, and went to the centre of Andromeda, moving in a zig-zag line, and changed colour, taking in succession the various tints of the rainbow. Last night also (11th August), falling stars were observed, almost in the same number as in the night of the 10th.

The details of our observations will appear in some scientific magazine, as they can interest those only who systematically cultivate science; meanwhile, we are asked by not a few of those, who however occupied with other studies, nevertheless feel the want and even necessity (such is the bond that unites all the branches of human knowledge) of knowing, at least, some general principles of the physical sciences, why every year observations are made of these falling stars, now that it is known to every one that it is a phenomenon of annual occurrence? We answer, that accurate observations of natural phenomena, even of the most com-

* By Professor Donati, in the "*Italia Nuova*," August 15th.

mon, are always desirable; as sooner or later they always serve some useful or entertaining object. But, moreover, in this case, notwithstanding that the phenomenon is periodically reproduced, it is not manifested constantly with the same intensity; since, in some years, very many falling stars are seen in August—in others, on the contrary, very few. Why is this? By researches made in late years by many learned men, and in particular by Professor Schiapparelli, it results that the so-called falling stars are unquestionably nothing but small corpuscules, found scattered and wandering throughout the infinite space of the universe; and which, when they approach the earth, are attracted by it and forced to run down with immense velocity within our atmosphere, in the which, by reason of the excessive friction which they undergo, they are inflamed and dissipated. This, for the most part, takes place in the elevated regions of the atmosphere; and then we have the phenomenon of the *falling stars*, properly so called. If, however, those corpuscules have a mass so great that all their matter cannot be dissipated in a very few moments, they pursue their course to lower regions of the atmosphere, and in this case we have the phenomenon of the *bolides*. If occasionally the corpuscules are sufficiently massive to last so long as to reach the earth, then we have the phenomenon of *aeroliths*; that is, of those *air-stones*, which have given origin to so many tales and so many false hypotheses.

These corpuscules, like the stars, are scattered throughout all space; and, in fact, no night passes in which, if the heavens be attentively observed for a certain time, some will not be perceived, under the form of falling stars; but just like the stars, which form here and there diverse agglomerations, of which the greatest we see is the *Milky Way*, do these cosmical corpuscules also form agglomerations in various parts, in relation to the which depends the manner in which the phenomena of the falling stars appear to us. If those corpuscules were not in their nature dark, or if, at least, they were sufficiently large and near to reflect sensibly to us the solar light, it would have been most easy to study their distribution; but since they manifest themselves to us as celestial bodies only in the moment in which they become, in reality, terrestrial, science has been obliged to collect a large number of facts, and to resolve also many very intricate geometrical problems, before it succeeded in explaining physically and mathematically the phenomenon of the falling stars.

Let us see how it explains the phenomenon of the falling stars of the 10th August. There exists around the sun a great ring (*armilla*), like a large skein (*matassa*) continuous, formed of very minute bodies, which without going out of it revolve round the sun in the interval of about 108 years, in virtue of the attractive force exercised on them by the sun itself. This ring, or skein, has a fixed position in space; or, at least, there are not yet facts enough ascertained to show that it changes its place. And that position is such, that when the earth in its annual revolution is found in that point of its orbit which corresponds to the 10th August, it is found at the same time in the neighbourhood of the said ring, round which, just as in a skein, there issue irregularly here and there a number of threads, which are formed by some of the corpuscules which constitute in their aggregate the ring itself. Then the earth, by reason of its attractive force, withdraws from the solar action those corpuscules of the the threads which are nearest to it, and draws them to itself, and thus we have the phenomenon of the falling stars; whilst the thick, that is to say the more compact portion of the ring, continues its course round the sun, and remains invisible to us. And, because the ring is not everywhere of the same thickness, but, like an entangled skein, has in some points swellings,

lumps, or knots, it happens that not every year our planet draws to itself the same number of little bodies; but more or less of them, according as it approaches more or less dense parts of the ring. Observations have shown that a great maximum in the number of the August falling stars occurs in about 108 years; and hence, it has been inferred that the corpuscular ring to which the August falling stars belong, however continuous—inasmuch as the phenomenon is observed every year in that month—has nevertheless in its extension a great condensation of corpuscules; and, since this maximum condensation returns at the end of 108 years to that point of space which the earth occupies on the 10th August, it follows that the ring completes its revolution round the sun in the above period of time.

Besides the falling stars of August, we have also those which are seen between the 13th and 14th November, which are called *Leonids*, because they describe lines which have all a point of concourse, or *radiant*, in the constellation of the Lion. But the phenomenon of November is very far from being so regular and constant as that of August. In fact, it has been observed that the maximum number of the falling stars of November happens about every period of 33 years, and that in the intermediate years, the number is very far inferior to that maximum. This leads to the conclusion that the falling stars of November, in place of being derived from a ring continuous and similar to that from which the August meteors have their origin, are rather derived from a band, nearly discontinuous, resembling one of those finger-rings in which, in comparison with the largeness of the gem, the rest of the circle is hardly noticeable. It appears, then, that those corpuscules are found for the most part agglomerated only in a small space, and that they form a kind of heap or assemblage, revolving round the sun in 33 years, and passing near that point in space which the earth occupies on the 13th November every year.

Besides the falling stars of August and November, there are also other secondary systems of these bodies, the periods of which are sufficiently well determined, but of which this is not the place to speak.

In the next place, it is a most important fact that there are some comets which move in space in the same orbits in which revolve the little bodies that generate the falling stars. It has, in fact, been recognised that the third comet which appeared in 1862 moves in an orbit identical with that in which the corpuscules revolve which occasion the August meteors; and that the first comet which appeared in 1866 has an orbit identical with that of the corpuscules which generate the falling stars of November. It appears, then, that comets are as it were the elder sisters of those little bodies which give rise to the falling stars, when they are turned out of their normal course and come to be immerged in our atmosphere. Comets, notwithstanding that they are dark, and continue always very far from the earth, are yet visible, because they are sufficiently large and condensed to reflect not a small quantity of the light which they receive from the sun, which the corpuscules above-mentioned cannot do, because they are too small and scattered.

From the little that has been thus far said, it appears clear that science has already done much for the investigation of the nature of the falling stars and comets; nevertheless, there remain not a few investigations to make, and very many facts to be explained, even in this vast branch of natural philosophy; in the which, almost continually, opportunities are offered to astronomers for undertaking patient observations, which, barren in appearance, yet always lead to the knowledge of new truths. At this time, for example, there is seen on our horizon a very small comet

that was discovered at Milan by the Sig. Tempel, which has so feeble a light, that even with our very powerful telescope, by Amici, we have only been able to observe it with difficulty ; still we have followed it with all the care and regularity possible, for the very reason that from the position it occupies on the celestial vault, and the extreme faintness of its light, this comet can only be observed in very few observatories. Small, however, as it is, it may be of great importance to science, since it is likely that it is the same comet which appeared in 1827. There is another small comet which will be observable before long; that is, the comet called Encke's, which, as is known, returns every three and a half years, and which is continually drawing nearer to the sun, into which sooner or later it must fall. This comet, by the constant diminution of its distance from the sun, has revealed to us the existence, and may hereafter bring us acquainted with the disposition and structure, of that *cosmical atmosphere*, which is called *æther ;* about which, hitherto, so little is known, although so much is continually said of it in all the physical sciences.

Royal Observatory of Florence :
August 12th, 1871.

THE GREAT NEBULA OF ETA ARGUS.

(Concluded from page 215).

"The drawing was then reduced to its present size with proportional compasses, and afterwards compared with the object, under different states of the atmosphere, with moon and without moon, and corrected until it was deemed a faithful representation of it as seen now.

"On comparing this with the Cape monograph, startling differences are found, not so great near Eta as some observers have thought, but far greater than any which astronomers have before witnessed. In the nebula in Orion the changes are so small as to be with difficulty made out ; but here the densest part in 1834-8 is now one of the faintest, while close to this another part of peculiar form has become the brightest patch in the nebula.

"Examining it more in detail, it is seen that the mass in which the lemniscate (or dark enclosed space) is situated is in general outline very much the same as it was thirty years since, and in some of its marked features exactly the same ; as for instance, the definite outline beginning at 70 s.—240," and running still exactly as Sir John Herschel has described it amongst some small stars, but round the border of the lemniscate great changes in the relative brightness of the different parts of the outline have taken place, and some slight changes in the outline itself, the greatest being at 17 s.—100" where one point now occupies the place of two in the Cape drawing ; and it is remarkable that it is just at this point that the large Melbourne reflector reveals rapid change at the present time ; the nebula also seems much brighter at this point than it was in 1834-8, judging from the parts which appear unchanged.

"It is, however, at the south end and following side that the most remarkable change has taken place: this end and half the side have now become so faint, that with small telescopes no nebula is seen at all ; while the other half of the same side has so much increased in brightness that it is now the most marked feature of the nebula, its outline on the preceding and north sides being very like that in the Cape drawing, while the following and south side of it form a curved line which seems faintly indicated in the same drawing. This is a very curious feature and seems to indicate that this is a nebula seen upon the fainter one. It has evidently

become much brighter since 1834-8, and is, I think, one of the principal causes of the increased visibility of the nebula being now always more conspicuous than any other part, and visible when they are lost in twilight or haze. In other respects this drawing seems to represent the same object as the Cape monograph, allowing for difference in the telescopes. The star No. 11 (664 H) is just in the edge of the nebula; and about midway between it and Eta is another star about fifteenth magnitude, not in this drawing or in the Cape list.

"Passing now to the branches, we find changes even more surprising than those already noted; I think without a parallel, and pointing to the urgent necessity for carefully recorded observations of all such objects, and if this square degree is to be taken as a sample, promising more discoveries than have ever before been made in so small a space. At the spot + 40 sec. + 600 min. in the Cape drawing is a mass of nebula forming one of its marked features, and particularly described by Sir John Herschel as so situated with regard to certain stars, that the least change would be apparent. Of this not a vestage is now to be seen; yet it was about as dense as that near Eta. Again, about star No. 100 (1103 H) there was a decided condensation of nebula, now it is not to be seen; and of the well-marked streams from stars Nos. 71 and 72, now nothing can be seen but a faint undefined haze, much fainter than that now about Eta. The nebulous branch, also, which terminated 150 sec. before Eta in the same parallel, now extends to over 200 sec. Some changes have, I think, taken place also at + 40 sec. + 1200 min.; but all is there so faint that I am doubtful about it. The oval shown in the north extreme of the Cape drawing is still the same, limited by the stars as it was then. In it I saw three minute stars; Sir John Herschel records four seen with his reflector.

"Taken as a whole, this object must have increased in brightness very much, for it can now be seen in full-moonlight; and in 1834-8 it was at all times invisible to the naked eye. This fact, and the great similarity in outline between the Sydney and the Cape drawing, have inclined me to think, that if the same reflector could again be turned to this object, the lemniscate would be found very little altered, and the apparent difference quite as much, perhaps more, in the increase of light at two points before indicated, as in the loss of light in other parts.

"Still a great change has taken place, and since Eta has only a very small proper motion, which with one exception appears to be common to the stars and nebulæ near it, and that the latter shows no signs of resolvability, even in the large Melbourne reflector; but, as far as the spectroscope has yet been applied, is gas, like the great nebulæ in Orion. I am inclined to think that the mass surrounding Eta and the leminiscate is in reality two or more nebulæ in visual superposition; and that the force, whatever it may be which renders them luminous, is decreasing in that in which Eta is seen, and increasing in that part north of Eta whose peculiarity in form was before remarked, for it seems more reasonable than to suppose that large nebulæ have had the necessary angular motion to bring them visually over other parts. A motion, be it remembered, so large that even astronomy presents us with no parallel; while, on the other hand, it is known that several nebulæ have faded in a few years so much that they could not be seen without the aid of large telescopes. Of this character was one discovered by Mr. Hind in 1852, it was observed rather bright by D'Arrest in 1853, by M. Auwers in 1858 fainter, and in 1861 he could not find it with the same telescope, $4\frac{1}{3}$-inch, or with a 6-inch. With the large refractor at Pulkowa it was seen but very faint indeed. Another one in Coma Berenices, discovered by Sir William Herschel, was missed in

1862. D'Arrest having found two nebulæ which he thought new, Sir John Herschel pointed out that his father found three in the same place; subsequently M. Foucalt's large reflector revealed the missing object, but it was very faint indeed.

"The extent of these faded nebulæ near Eta, if assumed to be at the distance of the nearest known fixed star (20 millions, 3¼ years' journey for light), is so great that space for thousands of solar systems such as ours would be found without the orbits of the most distant members overlapping; yet all has to our senses ceased to be in about 30 years—perhaps had done so when the Cape drawing was made, with light which may have been still streaming in from space."

LIST OF RECORDED MAGNITUDES OF ETA ARGUS

Year.	Magnitude.	Observer.
1677	4	Halley.
1751	2	Lacaille.
1811	4	Burchell.
to 1815	4	Burchell.
1822	2	Fellows
1826	2	Brisbane.
1827	1	Burchell.
1831	2	Taylor.
1832	2	Taylor.
(made in same year	2	by Johnson)
1833	2	Taylor.
1834	1·4	Herschel.
to 1837	1.4	Herschel.
1838	0.5	Herschel.
1842	1	Maclear.
1843	0.5	Maclear.
1845	1	Jacob.
1850	1	Gillis.
1854	1	Tebbutt.
(made in same year	1.2	by Powell.)
1856	1.5	Powell.
(made in same year	1.0	by Abbott.)
1858	2.3	Powell.
(made in same year	2.1	by Abbott).
1859	3.1	Powell.
(made in same year	2.7	by Abbott.)
1860	3.0	Tebbutt.
(made in same year	3.3	by Powell, and
	3.1	by Abbott.)
1861	3.6	Powell.
(made in same year	4.2	by Abbott.)
1862	4.9	Tebbutt.
(made in same year	4.9	by Abbott.
1863	5.1	Tebbutt.
(made in same year	6.0	by Abbott, and
	5.0	by Ellery.)
1864	5.2	Tebbutt.
1865	5.2	Tebbutt.
1866	5.8	Tebbutt.
1867	6.0	Tebbutt.
1868	6.0	Tebbutt.
1871	7.0	Russell.

"Mr. Russell was warmly applauded at the close of his remarks, and a vote of thanks for the paper was carried."

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MARS IN 1871.

In the months of March, April, and May, this somewhat difficult object was carefully watched, and some score of drawings made. The subjoined notes will, perhaps, convey a tolerably clear idea of the principal features observed on the disc.

March 23*rd*, 12*h*. The Northern snow-cap was large and bright. A large balloon-shaped figure lay along the diameter from north to south, its widest end being the southern. Above this, and encircling the southern pole, was a dark broad band. Projecting from this band towards the north were three dark forms, like claws, the two western ones having the points turned to the west, and the eastern claw having its point turned to the east.

The broad ends of these objects, on reaching the band, did not blend with it, but were much darker than it, and seemed to spring from the central line of the band. The pointed northern end of the balloon was cut off from the polar snow by a line of light.

April 6*th*, 11*h*. A dark broad band lay round the south pole, but on approaching the south-west edge of the disc it swept along the western limb, but stopped short of the northern snow-cap. To the east of its northern end, and lying south of the snow, lay a triangular dark patch.

A large circular bright spot lay near the curve, just described; it was on its eastern side, and near the middle portion of the curve.

April 4*th*, 11*h*. The northern and southern snows were well seen; the latter being much the smaller, and less distinct of the two.

A dark band surrounded the south pole; near its western extremity it had a dark spot in it. Close to this broad dark band was the base of a large triangular dark object. The base was parallel to the southern band; the apex of the triangle extended to the north beyond the centre of the disc. To the west of the apex, but near it, was seen a small narrow dark patch, lying east and west. Another dark spot lay some distance to the east.

Other minor features were seen, but none deserving of remark, except a very bright spot on the south-west edge of the disc, not far from the southern snow-cap. It lay just within the dark southern band, and at its western end. It closely resembled the snow about the south pole in shape and size.

Owing to the extreme unsteadiness of the air and the bad weather, no measurements could be obtained; and, therefore, no engravings are herewith sent. The drawings have, however, been lithographed as rough pictorial memoranda for future reference.

Mr. Birmingham, with his 4½ inch refractor, saw all the principal features observed here, and also one or two not observed at this place.

EDWARD CROSSLEY, F.R.A.S.
JOSEPH GLEDHILL, F.G.S.

Park Road Observatory, Halifax:
September 11th, 1871.

THE LUNAR CRATER LINNÉ.

Sir,—In my letter of March 3, 1871, see *ante*, No. 100, for April, p. 82, I quoted an observation of Linné, the object having been seen as a slight depression. On the 24th of June, 1871, 9.0 to 9.30. G.M.T., I observed Linné as a white spot, somewhat faint. The wind was occasionally troublesome, but at times the definition was remarkably superb; when Linné assumed the aspect of a *very shallow crater*, about the size of Sulpicius Gallus, which was exceedingly well seen. Bessel was also very distinct, and the shadow of the ridge from Sulpicius Gallus to Linné well marked. Posidonius γ presented its well-known mountain character, and on it, as well as on Linné, the white cloud seen under a later illumination was not apparent. The difference in aspect between Bessel and Sulpicius Gallus on the one hand, and Linné on the other, was very marked. Bessel and Sulpicius Gallus being seen distinctly as craters. The three craters N.W. of Linné were not seen, while the dark western border of the Mare Serenitatis was very distinct, and the line of demarcation between it and the lighter and more central portions of the Mare quite arrested the attention. I may just remark that nothing has reached me bearing on the errors of Lohrmann, Beer, and Mädler, and Schmidt. Are we without evidence to conclude that their drawings of Linné were inaccurate?

Yours truly,

Walthamstow: August 12, 1871. W. R. BIRT.

P.S.—In an article entitled "St. Lawrence's Tears," in the *Daily Telegraph* of August 11, M. Mennier's view of the clefts on the moon's surface is quoted. "He sees in the geological 'faults' of our globe the symptoms of such a disruption, and a more palpable manifestation of it is to be witnessed upon the moon, whose crust is scored by deep fissures a mile wide and hundreds of miles in length, which fissures, there is some reason to believe, are increasing in extent and number."

DESIDERATA.

Sir,—"Egens" and Captain Noble have mis-read my words, "of no navigational value," which have nothing to do with the Satellites of Jupiter, but only refer to Uranus. I should have imagined the paragraph was clear enough, but as more than one person has misapprehended it, it is as well to point out their mistake. I should fancy 19 seconds is rather an exceptional amount for the errors in the eclipses of the 1st Satellite; but even, otherwise, he would be a poor navigator, who should land his ships on a reef, after getting his longitude as near as that. Any thing under a quarter of a degree should lead him to be "thankful," if not, "to rest." At the very meeting of the R.A.S., when Capt. Noble is reported to have made the indiscriminating onslaught on the Nautical Almanac, which partly drew forth my letter, both the Astronomer Royal and M. Dunkin testified to the general accuracy of the times of the eclipses of the 1st and 2nd Satellites. (See Register, pp. 131, 132.) As far as my own experience goes, making allowance for the greater uncertainty when Jupiter is low down in the heavens, or near the sun, and when the phenomenon occurs very near the planet, I can by no means agree with Capt. Noble, that these phenomena are "valueless at present." Upon reflection, perhaps, he would admit *this* to be "exaggeration," and I much question his idea (if I understand him aright), that the Tables of Uranus admit of being touched up in their actual condition. I find the

Astronomer Royal declares that "Tables could not be corrected by bits, but must be done throughout at once :" (Register, p. 132.) and, the gist of my difference with your two correspondents is, that we cannot expect so great a work as this to be performed either at Greenwich, or in the office of the Nautical Almanac.

I only add, that I demur to the fairness of some of the remarks in both the letters before me ; but, acquitting their writers of being intentionally unfair, and wishing them many years of health and facilities for cultivating the noble science we are all agreed in devotion to,

I remain, yours, &c.,

Teignmouth : Sept. 1871. GEORGE J. WALKER.

SIR,—I think it would be very ungracious and ungrateful on my part, were I not to hasten to acknowledge my deep sense of obligation for the very kind and considerate commiseration, expressed by your Whitburn correspondent, for my "knowledge" (or, rather, I should fancy lack of it) "of the requirements of practical astronomical horology." But, I regret, the information conveyed in his communication is not much calculated to improve or extend it. I should have conceived it had been already generally well known that a common eight-day clock could very readily be rated and set to sidereal time, had not Mr. Allinson recommended it rather in the light of a novelty. Chambers, in his "Description of Astronomy," page 703, says—"A chronometer, or well made clock, set to sidereal time is needed. It is by no means necessary in a general way that this should be an expensive or highly exact instrument. An ordinary good parlour timepiece, costing from 6*l* to 10*l*, will meet all the requirements of the amateur ;" and, I think I can even, in my state of lamentable ignorance suggest an amendment on the "old eight-day long cased clock, with 40 inch pendulum," by converting the said clock into a "three-quarter length," by hanging the weights by three strings instead of two, the lower pulley being let into the weight instead of being placed some inches above it. The case may then be cut off to the length required for a seconds pendulum. Mr. Allinson appears to ignore altogether, or, at any rate, not to appreciate, the comfort and convenience afforded by having a clock fitted with a well-divided and clearly figured sidereal dial, a clock beating seconds in a loud and distinct manner, and striking the minutes; also, the small size of the clock, which enables it to be placed in small gazebos or observatories, on an isolated brick or stone pier, perfectly free from vibration, as such clocks should ever be, and as steady as the equatorial itself. "The bare idea" of the clock I mentioned in my reply to the query of "Egens" being "a spring clock" really is not so "simply absurd" as Mr. Allinson "suspects." The necessity for the correct performance of marine chronometers is universally admitted, and magnificent eight-day instruments are now produced by our leading makers, which vie in accuracy of time-keeping with those requiring to be wound up every 24 or 48 hours, and yet in these marvellously exact instruments the motive-power is a spring. Drawing-room and library clocks of unimpeachable veracity are all, or nearly all, driven by springs, and some of the most beautiful specimens of the mechanical skill of the "old masters" in horology are similarly actuated. The new 5*l* sidereal clock was never intended to supersede the costly and exquisitely manufactured Observatory Sidereal Regulator of the professional astronomer, but designed simply as a trustworthy and efficient adjutor to the amateur astronomer. In fact, it must be regarded in the same light as the cheap and excellent

educational, optical, and other scientific instruments now offered by enterprising firms to the intellectual public, and we must remember that many and great discoveries have been made, and good services rendered to science, by men provided with very modest instrumental means. In reply to the doubt expressed by "Egens" of the capability of a 10-in. pendulum to beat seconds, I beg to assure him that, with Mr. Cock's arrangement of the chronometer escapement, it does so most accurately. I merely recommend the Dipleidoscope to time the clock by, not as a substitute for the Transit, a cheap and reliable form of which I hope soon to see advertised.

I am, Sir, yours most obediently,

HABENS.

AUGUST METEORS.

SIR,—The annual display of August meteors this year was unusually fine, and far surpassed, as to number and brilliancy, the shower of last year. The weather was all that could be desired, clear, cool, and nearly destitute of moonlight.

In the north the Aurora held sway, but was confined to a steady light near the horizon, with only now and then a few streamers.

During the night of the 9th, from 12 m until 2 a.m., there were seen by two observers, 142; 72 the first hour, and 70 the last. 8 were of the 1st magnitude, 16 the 2nd, 28 the 3rd, 30 the 4th, and 60 the 5th.

On the eve of the 10th, there were seen 567 in 5 hours, from 10 p.m. until 3 a.m., as follows:

Hour.	1st Mag.	2nd.	3rd.	4th.	5th.	Total.
10 p.m. to 11 p.m. ...	3	3	9	14	20	49
11 p.m. to 12 m. ...	14	15	22	19	42	112
12 m. to 1 a.m. ...	12	12	13	27	58	122
1 a.m. to 2 a.m. ...	11	10	22	21	67	131
2 a.m. to 3 a.m. ...	12	12	26	35	68	153
	52	52	92	116	255	567

A grand total for the two evenings of 709. Last year, three observers, 4 hours, counted 302. The first magnitude ones were all more or less brilliant, with trails lasting from 1″ to 9″. The colours were orange and violet, and the radiating point seemed to be from Algol in Perseus.

Of the most remarkable ones, one of the 1st magnitude separated after shooting 10″, and formed two, and continued on for 20° more; and one of the 2nd magnitude was 8″ in traversing a space of 20°. As to size, the most brilliant ones were about the apparent magnitude of *Venus*.

If favourable, the 13th and 14th of November, an observation will be taken all night, when a more interesting account will, no doubt, be recorded, as in 1868 over 5,000 were counted by three observers.

E. F. TANGER, S.A.S.

Boston: Aug. 14, 1871. H. E. STEVENS, S.A.S.

OLD STAR MAPS.

SIR,—Can any of your correspondents give the title of a folio book, published somewhere about 1600, in which the constellations are arranged with Christian figures instead of Lyra, Bootis, &c. ?

I think it was done by the Jesuits. I should much like to know where a copy is to be seen.

S. S.

NEPTUNE.

SIR,—Neptune is now near the double star 123, Piscium, which Webb calls a "fine test, requiring beautiful weather." I have seen it well with my 3¾-in. aperture achromatic, and 175 power. Should any readers of the *Astronomical Register* wish for a diagram of the small stars near Neptune, in order to make sure of him, I will forward it on application enclosing a postage stamp.

Yours, &c.,

GEORGE J. WALKER.

Teignmouth, Devon: Sept. 12, 1871.

OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS TO JULY 31, 1871.

Solar Spots.—Mr. T. W. Backhouse, of Sunderland, obtained the following measurements of a large spot that was perceptible on the sun:—On the 12th, at 9h 12m. a.m., the umbra was 20,000 miles long; on the 15th, at 9h. 15m., a.m., the penumbra was 36,000 miles in length; on the 18th, at 7h. 45m., a.m., the dimensions of the penumbra and umbra were 37,000 miles and 22,500 miles respectively. At this time, the width of the umbra was 14,500 miles. On the 20th the spot had increased in magnitude, the penumbra being 41,000 miles long, while the umbra was equal to 27,500 miles. It had decreased in size on the 22nd. Mr. Backhouse remarks that it was the largest umbra he ever saw.

Comets I. and II., 1871.—Mr. John Birmingham, of Tuam, writes as follows:—I had several observations of Comet I. from April 22 to May 8, but under very unfavourable circumstances, caused by the state of the atmosphere and strong moonlight and twilight. Still, notwithstanding its faintness, a nucleus was easily detected, and the comet seemed in general to present a granulated appearance. On April 22, it was not visible in the finder, but bore magnifying up to 126 very well. There was a slight elongation in the normal direction of a tail. By the best measurements that I was able to apply, the comet seemed always slightly in advance of the position computed by Pechüle. On July 17, at 12h. 15m., Dublin mean time, I first found Comet II., the cloudy weather having rendered a previous search ineffectual. This comet was of extreme faintness, and, without the sharpest attention, it might easily pass unnoticed across the field. When first observed, it was in contact with a small star, not identified, from which it gradually detached, and its position seemed to agree with Pechüle's calculation. It was best seen with 56 and 99; and, with the latter, after intent gazing, the momentary flickerings of minute points in its misty form could be caught at instants of good definition. This so strongly suggested the appearance of a nearly resolvable cluster, that I was not satisfied with the comet's identity until I

perceived its motion. Previous to this observation, I had not read the description of the object by Herr Tempel, the discoverer; but, subsequently, I was pleased to see his allusion to its appearance as if sprinkled towards the middle with little stars. If the light of the comet is sufficient, I shall not be surprised to hear of its giving indications of a continuous spectrum, in addition to the usual bright lines." Mr. Charles Hill, of Bristol, also observed Comet II. with his 8¼-inch equatorially mounted reflector. He examined it for some time during the night of July 18—19, but it was so exceedingly faint that it could only, with great difficulty, be detected.

Venus.—Mr. Henry Ormesher, of Manchester, has frequently observed this planet during the last few months. He has on several occasions succeeded in detecting the dark markings. He says:—"May 10, 8h.—The markings were clear and well defined, and reminded me very much of the planet Mars, having much the same appearance." On May 21 and 29 he also saw dusky markings on the planet's surface, with his 5¼-inch refractor, power 181. Mr. John Birmingham reports, that although he has been carefully observing Venus at every opportunity, he has failed to detect "any definite markings besides the well-known peculiar forms exhibited by the cusps, which appear to be brighter than other parts of the planet." Mr. H. W. Hollis, of Keele, Staffordshire, examined Venus on July 17, at 6h. 30m., with his 6-in. O. G., power 150. "The rounding off of the southern cusp was evident at a glance, and the prolongation of the northern one more remarkable than I have ever before observed it; a dusky, ill-defined, and uncertain-shaped spot was visible. On the 18th, at 5h. 15m., I suspected the presence of this spot again, somewhat nearer to the terminator, but of this I cannot speak positively."

OBSERVATIONS TO AUGUST 31, 1871.

SOLAR PHENOMENA.

Mr. T. W. Backhouse, of Sunderland, reports that "a fine group of spots passed the sun's centre in the southern hemisphere on the 17th of last month. I made the following measurements, in miles, of its chief spot:—

Date.	h.	m.	Umbra. Length.	Penumbra. Length.	Penumbra. Width.
August 11	21	20	...	82,000	46,000
13	21	20	...	71,000	about 18,000
14	3	30	14,500	...	...
14	20	0	16,500	66,000	...
15	21	15	16,500	65,000	34,000
18	3	30	9,500	59,000	39,000
20	21	0	...	75,000	...
21	21	20	rather small	divided into 4	...

"The penumbra had a more ragged appearance than is often the case. If this group has returned to this side of the sun, it contains no important spots this month. Another very fine group passed N. of the sun's centre on the 19th of last month (August). It generally contained two or three large penumbra, of which I made several measurements, and on the 18th they were united at 3h. 30m., making a penumbra 78,500 miles long, and 41,000 wide at its widest part, and at 21h. 10m., 84,000 miles long. By the 25th all its spots were so reduced as to be quite small."

AUGUST METEORS.—The Rev. S. J. Johnson, of Upton Helions Rectory, Devon, writes :—"The following watch I kept with regard to the August meteors shows they were seen to considerable advantage this year :—

Date.		Duration of Watch. h. m. h. m.		Number Seen.
August 9	...	10 15 to 10 40	...	1
9	...	11 13 to 11 52	...	7
10	...	9 44 to 10 34	...	11
10	...	11 4 to 12 12	...	42
11	...	10 36 to 11 36	...	20
12	...	10 56 to 11 28	...	5

"They were of a finer class than those of the last few years. Ten of those on the 9th were equal to 1st Mag. stars. Nearly all left momentary trains. On the 9th a very bright one burst into view a little below δ Cassiopeiæ, and shot towards η with a train of sparks. One on the 10th, near Cor. Caroli, was equal to Venus. I fancied the radiant point on the 9th was a trifle to the left of the cluster 33 ♅, but subsequent nights made me think it much lower down in Perseus." Mr. William F. Denning, of Bristol, observed the following number of meteors during a portion of three evenings of observation :—

Date.		Duration of Watch. h. m. h. m.		Number Seen.
August 9	...	11 30 to 12 0	...	7
	...	12 0 to 13 0	...	27
	...	13 0 to 14 0	...	8
	...	14 0 to 15 0	...	21
10	...	10 0 to 11 0	...	17
	...	11 0 to 12 0	...	27
	...	12 0 to 12 30	...	27
11	...	10 35 to 10 50	...	18
	...	11 0 to 12 0	...	29
	...	12 0 to 12 15	...	16
	...	12 15 to 12 30	...	15
	...	12 30 to 13 0	...	23
	...	13 0 to 13 15	...	11
	...	13 15 to 13 30	...	14

"Most of the meteors observed, especially those on Aug. 9, were exceedingly small and scarcely discernible. Several brilliant ones were, however, observed. At 12h. 23m. on Aug. 10, a meteor of great lustre, and star-like in appearance, diverged from Perseus towards the horizon; it was of a blue colour, and left a trail of light marking its path, which was visible for a few seconds. At 10h. 44m. on Aug. 11 another brilliant one was observed. It passed equal to Venus, and was visible in Ursa Minor. The train which it left remained perceptible for a few seconds. It was, however, at about 12h. 50m. on the latter date that the most brilliant meteor was observed. It passed between the fourth Mag. stars ϵ and ζ in Cygnus, and soon afterwards disappeared, leaving in its flight a train which could be seen for about 7 seconds after the extinction of the meteor itself. This one, like the great majority of those observed, radiated from or near the small star B in Camelopardalus, situated at about R. A. 48° 37′ and N. D. 59° 18′. There were several small meteors observed in close proximity to this point; not many were seen to come from other directions. At 11h. 25m. on Aug. 10 a rather brilliant one passed from the bright star Scheal in Pegasus to Cassiopeia."

ENCKE'S COMET, OCTOBER, 1871.

1871.		R.A. h. m. s.		Decl. ° ′
Oct. 1	...	1 43 41	...	+33 37
3	...	1 39 6	...	34 12
5	...	1 33 55	...	34 48
7	...	1 28 4	...	35 23
9	...	1 21 28	...	36 59 – 16. 43
11	...	1 14 3	...	36 33
13	...	1 5 43	...	37 7
15	...	0 56 25	...	37 39
17	...	0 46 4	...	38 8
19	...	0 34 34	...	38 34
21	...	0 21 52	...	38 54
23	...	0 7 56	...	39 8
25	...	23 52 45	...	39 14
27	...	23 36 19	...	39 10
29	...	23 18 44	...	38 54
31	...	23 0 7	...	38 24

A New Minor Planet, No. 114 of the Series, was discovered by Dr. C. H. F. Péters, at Hamilton College, Clinton, U.S., on July 23rd, 1871. It was also found independently on Aug. 6th, by J. C. Watson, at Ann Arbor, Michigan, U.S.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN OCTOBER, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight. ° ′		Objects to be observed.
16	... 143 10·9	...	Azout, Bernouilli, Struve.
17*	... 129 40·4	...	Biela, Boguslawsky, Boussingault.
18	... 116 16·1	...	Guttemberg (*a*), Bohnenbeger the Pyrenees.
19	... 103 1·1	...	Arago, Mt. Argæus, Arnold.
20	... 89 56·9	...	Stöfler (*b*), Aristillus (*c*), Autolycus.
21	... 77 4·2	...	Archimedes (*d*), Cassini, Apianus.
22	... 64 23·0	...	Nasireddin, Huggins, Miller (*e*).
23	... 51 53·3	...	Beer and Mädler (*f*), Tobias Mayer.
24	... 39 35·4	.	Bessarion, Encke, the Mare Humorum (*g*).
25	... 27 29·7	...	Campanus, clefts in its neighbourhood.
26	... 15 36·8	...	Bayer, Billy, Hainzel.
27	... 3 57·0	...	Cardanus, Krafft, Olbers.
28	... −7 29·5	...	Rock Mountains, Inghiransi.

For additional objects consult the lists for June and August.

* Moon near mean libration. The Epoch of mean libration is Oct. 4.

*** It is very important to register the extents of shadows near the terminator in part of the diameters of Craters, and in the case of mountains in diameters, their multiples and parts of the apparent diameters of their bases.

(*a*) A re-observation of the objects figured by Birmingham, near Guttemberg, is very desirable. See list for August.

(*b*) The same remark applies to Stöfler. The largest Crater on the S.W. of Stöfler has been named FARADAY.

(*c*) Should Aristillus be in sun-light, a ring on its Northern border may be looked for. It should be carefully drawn and its features described. It is evanescent and is soon lost sight of. If not in sun-light, on the 20th, look for it on the next evening.

(*d*) See *English Mechanic*, No. 334, Aug. 25th, 1871, p. 565, for a sketch by Gaudibert, of Archimedes, with the clefts in its neighbourhood.

(*e*) The Craters on the S.E. and N.W. of Nasireddin have been named HUGGINS and MILLER respectively, to commemorate the joint Spectroscopic labours of these physicists.

(*f*) A fine pair of small Craters between Archimedes and Timocharis.

(*g*) The Ridges and Craters on the surface form a fine study during the passage of the terminator.

Errata in former lists: July 29, for *Blancauus* read *Blancanus*; Aug. 24, for *Pietel* read *Pictet*; Sept. 18, for *Mesius* read *Metius*; Sept. 19, for *Cyrillius* read *Cyrillus*; Sept. 21, *dele* comma between Sulpicius and Gallus; Sept. 23, for *Bouplund* read *Bonpland*; Note (*f*), for *hue of light* read *line of light*.

Errata, page 207, par. 2, line 5, for *where* read *whence*. Page 208, line 24, for *shown* read *shews*. Line 9 from bottom, for *Satellite* read *Satellite I.* Line 21 from bottom, for *Phenomena* read *Phenomenon*.

SUN.

Greenwich, Noon. 1871.	Heliographical longitude of the apparent centre		Heliographical latitude of the sun's disc.	Angle of position of the sun's axis.
	°		°	°
Oct. 1	125·57	—92 δ ξ	+6·62 N	26·21
2	138·78		6·57	·27
3	151·99		6·52	·33
4	165·20		6·46	·37
5	178·41		6·41	·41
6	191·62		6·35	·45
7	204·83		6·29	·47
8	218·14	—85 δ ξ	+6·22	26·49
9	231·44		6·16	·50
10	244·55		6·09	·51
11	257·66		6·02	·50
12	270·86		5·95	·49
13	284·07		5·88	·47
14	297·28		5·80	·44
15	310·48	—78 δ ξ	+5·73	26·41
16	323·69		5·65	·37
17	336·89		5·57	·32
18	350·10		5·49	·26
19	3·30		5·40	·20
20	16·51		5·32	·13
21	29·71		5·23	26·05
22	42·91	—71 δ ξ	+5·15	25·96
23	56·12		5·06	25·86
24	69·32		4·96	25·76
25	82·52		4·87	25·65

26	95·73		4·78	25·53
27	108·93		4·68	25·40
28	122·13		4·59	25·27
—				
29	135·34	—64 δ ξ	+4·49	25·13
30	148·54		4·39	24·98
31	161·74	—62 δ ξ	4·28 N	24·82

MOON'S TERMINATOR.

Greenwich, Midnight	60°N.	0°	60° S.
	SUNSET.		
	°	°	°
1871. October 1	+58·1	+55·3	+52·9
2	45·9	43·3	40·7
3	33·7	31·1	28·6
4	21·5	19·0	16·4
5	+9·3	+6·8	+4·2
6	—2·9	—5·4	—8·0
7	15·1	17·6	20·1
—			
8	27·3	29·8	32·3
9	39·5	42·0	44·5
10	51·8	54·2	56·7
11	64·0	66·5	68·9
12	—76·2	—78·7	—81·1
	SUNRISE.		
16	+50·1	+52·5	+54·8
17	38·0	40·3	42·6
18	25·8	28·1	30·4
19	13·6	15·9	18·2
20	+1·5	+3·7	+5·9
21	—10·7	—8·5	—6·3
—			
22	22·8	20·7	18·5
23	35·0	32·8	30·6
24	47·1	45·0	42·8
25	59·2	57·1	55·0
26	71·4	69·3	67·2
27	—83·5	—81·4	—79·4
	SUNSET.		
28	+88·6	+86·4	+84·4
—			
29	76·4	74·3	72·3
30	64·1	62·1	60·2
31	+51·9	+50·0	+48·1

METEOR.—On the Evening of September 6th, at about 9h. 20m. a magnificent bolide, with a luminous train, which remained visible for 7 or 8 seconds, was observed at the Royal Observatory of Florence, near Arcetri. It traversed the constellation of the *Dragon*, and went towards the *Great Bear*. Before and after its appearance, there fell a light rain of very small meteors, which had the constellation of *Cassiopeia* for their radiant point.—*L'Italie*. Sept. 8th.

VARIABLE STARS.

1871.	G. M. T. h m.			mag.	Place of Star 1855. A. R. h. m. s.	Decl. ° ′
Oct. 2	6 1	U Coronæ ...	min.	9 ...	15 12 17	+32 10·8
3		R Aquilæ ...	max.	6·7 ...	18 19 23	+8 0·8
11		R Vulpeculæ...	—	7·5 ...	20 57 56	+23 14·9
12	15 1	Algol ...	min.			
13	17 6	λ Tauri ...	—			
14		S Leonis ...	max.	9 ...	11 3 21	+6 14·9
15	11 9	Algol ...	min.			
16		S Sagittarii ...	max.	9·8 ...	19 10 57	—19 17·1
17	15 1	S Cancri ...	min.	10 ...	8 35 39	+19 33·2
—	16 5	λ Tauri ...	—			
18	8 7	Algol ...	—			
—		R Sagittæ ...	—	10 ...	20 7 27	+16 17·4
—		S Vulpeculæ ...	—	9·5 ...	19 42 27	+26 55·7
19		T Piscium ...	—	11 ...	0 24 29	+13 48·0
20		R Cancri ...	max.	6·3 ...	8 8 34	+12 10·1
—		R Pegasi ...	—	7 ...	22 59 22	+9 45·7
21	15 4	λ Tauri ...	min.			
24		T Herculis ...	max.	7·5 ...	18 3 37	+30 59·9
25	14 2	λ Tauri ...	min.			
26	10 1	U Coronæ ...	—	9 ...	15 12 17	+32 10·8
—		S Ursæ maj ...	—	11 ...	12 37 35	+61 53·3
27		T Pegasi ...	max.	9 ...	22 1 49	+11 49·9
29	13 1	λ Tauri ...	min.			
30		S Arietis ...	max.	10 ...	1 56 51	+11 49·7

COMET II. 1871.

M. Schulhof has calculated the following elements of the Orbit of this body:—

Perihelion Passage	=July	26·97 B.M.T.
		° ′
Longitude of Perihelion	=	308 10
Longitude of Ascending Node	=	211 56
Inclination of Orbit	=	101 59
Longitude Perihelion distance	=	0·034819

The following ephemeris for the current month will be useful to many of our readers:—

1871.	R. A. h. m. s.	Decl. ° ′	Luminosity.
October 2 ...	4 27 4 ...	+55 43 ...	1·87
4 ...	4 10 39 ...	54 12 ...	
6 ...	3 53 41 ...	52 27 ...	1·96
8 ...	3 37 8 ...	50 25 ...	
10 ...	3 21 6 ...	48 8 ...	2·0
12 ...	3 5 51 ...	45 36 ...	
14 ...	2 51 28 ...	42 51 ...	1·99
16 ...	2 38 1 ...	39 55 ...	
18 ...	2 25 33 ...	36 51 ...	1·90
20 ...	2 14 5 ...	33 43	
22 ...	2 3 35 ...	30 33 ...	1·73
24 ...	1 54 1 ...	27 24	
26 ...	1 45 19 ...	24 19 ...	1·52
28 ...	1 37 28 ...	21 20 ...	
30 ...	1 30 22 ...	18 30 ...	1·29

ASTRONOMICAL OCCURRENCES FOR OCTOBER, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn
Sun	1		Sidereal Time at Mean Noon, 12h. 39m. 6·59s.			— 5 36·2
Mon	2		Sun's Meridian Passage, 11m. 11·20s. before Mean Noon			5 32·5
Tues	3					5 28·7
Wed	4	20 19	Conjunction of Venus and Mercury, 4° 41′ N.	3rd Sh. E. 2nd Sh. I. 3rd Tr. I. 1st Ec. D. 2nd Tr. I.	14 6 15 23 16 1 17 40 24 17 57	5 25·0
Thur	5			1st Sh. I. 1st Tr. I. 1st Sh. E.	14 50 16 5 17 9	5 21·2
Fri	6	5 31·6	☾ Moon's Last Quarter	1st Ec. D. 2nd Oc. R. 1st Oc. R.	12 8 42 15 22 15 41	5 17·5
Sat	7	9 27 16 14	Conjunction of Moon and Jupiter, 2° 36′ S. Conjunction of Moon and Uranus, 2° 29′ S.	1st Sh. E. 1st Tr. E. 4th Sh. I. 4th Sh. E.	11 37 12 54 13 59 17 20	5 13·7
Sun	8					5 10·0
Mon	9		Saturn's Ring: Major Axis=36·77″ Minor Axis=16·35″			5 6·3
Tues	10					5 2·6
Wed	11	15 53 16 50 15 0	Occultation of ν Virginis (4½) Reappearance of ditto Conjunction of Moon and Venus, 11° 54′ S.	3rd Sh. I. 2nd Sh I. 3rd Sh. E.	14 58 17 56 18 16	4 58·9
Thur	12		Conjunction of Moon and Mercury, 3° 17′ S.	1st Sh. I 1st Tr. I.	16 44 18 1	4 55·2
Fri	13	18 19·3	● New Moon	2nd Ec D. 1st Ec. D. 1st Oc. R. 2nd Oc. R.	12 31 23 14 1 50 17 36 18 1	4 51·5
Sat	14			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	11 12 12 30 13 31 14 49	4 47·8
Sun	15	23 25	Opposition of Neptune Illuminated portion of disc of Venus=0·108 " Mars=0·919	1st Oc. R. 2nd Tr. E. 3rd Oc. R.	12 4 12 45 13 37	4 44·1

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Mon	16		Sidereal Time at Mean Noon, 13h. 38m. 14·89s.	4th Oc. D. 4th Oc. R.	11 46 15 43	4 40·5
Tues	17	12 7	Conjunction of Moon and Mars, 2° 2′ S.			4 36·8
Wed	18	21 34	Conjunction of Moon and Saturn, 1° 31′ N.			Moon. — 3 47·1
Thur	19		Sun's Meridian Passage 14m. 54·08s. before Mean Noon			4 48·3
Fri	20	11 54·3	☽ Moon's First Quarter	2nd Ec. D. 1st Ec. D.	15 7 45 15 54 57	5 48·9
Sat	21			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	13 6 14 24 15 25 16 43	6 47·0
Sun	22			3rd Ec. R. 2nd Tr. I. 2nd Sh. E. 1st Oc. R. 3rd Oc. D. 2nd Tr. E. 3rd Oc. R.	12 12 28 12 25 12 39 13 58 14 10 15 19 17 37	7 41·6
Mon	23	8 40 9 14 9 50 11 0	Occultation of τ^1 Aquarii (6) Reappearance of ditto Occultation of τ^2 Aquarii (4) Reappearance of ditto	1st Tr. E.	11 12	8 32·6
Tues	24			4th Sh. E.	11 26	9 20·4
Wed	25					10 5·9
Thur	26					10 50·0
Fri	27	20 14·1 17 0 17 54	○ Full Moon Occultation of ξ^1 Ceti ($4\frac{1}{2}$) Reappearance of ditto	2nd Ec. D. 1st Ec. D.	17 44 7 17 48 4	11 33·7
Sat	28			1st Sh. I. 1st Tr I. 1st Sh. E. 1st Tr. E.	15 0 16 17 17 18 18 36	12 17·8
Sun	29		Saturn's Ring: Major Axis=35·69″ Minor Axis=15·79″	1st Ec. D. 2nd Sh. I. 3rd Ec. D. 2nd Tr. I. 2nd Sh. E. 1st Oc. R. 3rd Ec. R. 2nd Tr. E.	12 16 19 12 19 13 0 26 14 57 15 12 15 50 16 11 36 17 51	13 2·9
Mon	30	8 50	Near approach of B.A.C. 1361 (6)	1st Tr. I. 1st Sh. E. 1st Tr. E.	10 45 11 47 13 4	13 49·3
Tues	31	10 33 11 38	Occultation of *n* Tauri (6) Reappearance of ditto	1st Oc. R. 2nd Oc. R.	10 18 12 32	13 37·2

THE PLANETS FOR OCTOBER.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	11 28 38	+4 40	7″·2	22 45·8
	15th	12 43 34	−2 40	5″·3	23 5·5
Venus ...	1st	11 45 10	−6 51	58″·4	23 2·3
	15th	11 33 25	2 27½	51″·8	21 55·5
Jupiter ...	1st	7 55 10	+20 58½	34″·2	19 12·9
	15th	8 1 54	21 41½	34″·4	18 24·6
Saturn ...	1st	18 16 14	−22 50	14″·8	5 36·2
	15th	18 19 13	22 50½	14″·6	4 44·1
Neptune ...	4th	1 27 38	+7 18	3″·0	12 36·6
	16th	1 26 24	+7 10	3″·2	11 46·2

Mercury is excellently situated for observation in the morning, rising at the beginning of the month, nearly two hours before the sun, the interval decreasing to twenty-one minutes at the end of the month.

Venus rises at the beginning of the month, about half-an-hour before the sun, the interval increasing. Towards the middle of the month she will be worth observing.

Jupiter rises at the beginning of the month five hours and a half after sunset, the interval decreasing.

Saturn sets earlier each day, the interval varying from four hours to three hours and a quarter after sunset.

THE STABILITY OF THE UNIVERSE.

Should the rotation of the earth on its axis be increased by five seconds of time in twenty-four hours all the time-keepers in all the watch-towers of the world would proclaim the fact—all the stars would fail to keep their appointed meridian transits, and would, in sympathy with the great orbs of light, linger in their nocturnal march. The bursting out in the heavens of a thousand fiery comets in a single night could produce no such mortal terror to the astronomer, as this falling backward of the mighty sphere of the starry universe for one single second in twenty-four hours, for it would speak the doom of the universe, in announcing that God's right arm was growing heavy, and his omnipotent will was commencing to stagger under the weight of ten millions of rolling worlds. Should such an event ever occur—should the time ever come when indeed those shining sentinels in the high heavens should fail to keep their appointed vigils—when the astronomer shall look wistfully

through the "optic tube" for the coming of the faithful star which, prompt to the thousandth of a single second, has traversed his meridian line, and, lo! the star lingers in its journey, seconds ebb slowly away and merge into minutes, and at last the star appears, no matter if with its wonted beauty, the astronomer stands aghast, and well may he tremble, for the powers of the heavens are smitten, and God is deserting the universe which sprang into being at his divine command. Human confidence and faith would be gone for ever, and no remedy could avail to rectify the wrong.

We have no fears that our confidence will ever be thus rudely shaken, not because we believe nature and her laws to be eternal, not because we believe that this stupendous mechanism endured from all eternity—for even then, after countless revolutions, a fault, an anomaly, a failure in the series of sequences might occur, and, with its terrific utterance, announce the possible running doom or destruction of the mechanism, but because I believe that God, the Eternal, All-wise, Incomprehensible, created and now sustains all things by the word of his power; it is because of God's eternity that we dwell in simple trust upon an unshaken order and a purpose to be achieved.—From *The Astronomy of the Bible.* By the late Professor and General O. M. Mitchel, U.S, formerly Director of the Cincinnati and Dudley Observatories.

The New Planet No. 114 has been named *Cassandra.*

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To September, 1871.

Elliott, R.

To December, 1871.

Gooch, Miss.
Guyon, G.
Holden, Rev. T. W.
Lawton, W.
Slater, J.
Weightman, Miss.

September 21, 1871. Subscriptions after this date in our next.

TO CORRESPONDENTS.

In answer to a Correspondent, we prefer to receive subscriptions in January and June.

We have received an interesting pamphlet, entitled "Notes on Eclipse Photography," by Mr. A. Brothers, describing minutely the photographic apparatus used at Syracuse; published for the benefit of those who wish to take part in the observation of the eclipse in December.

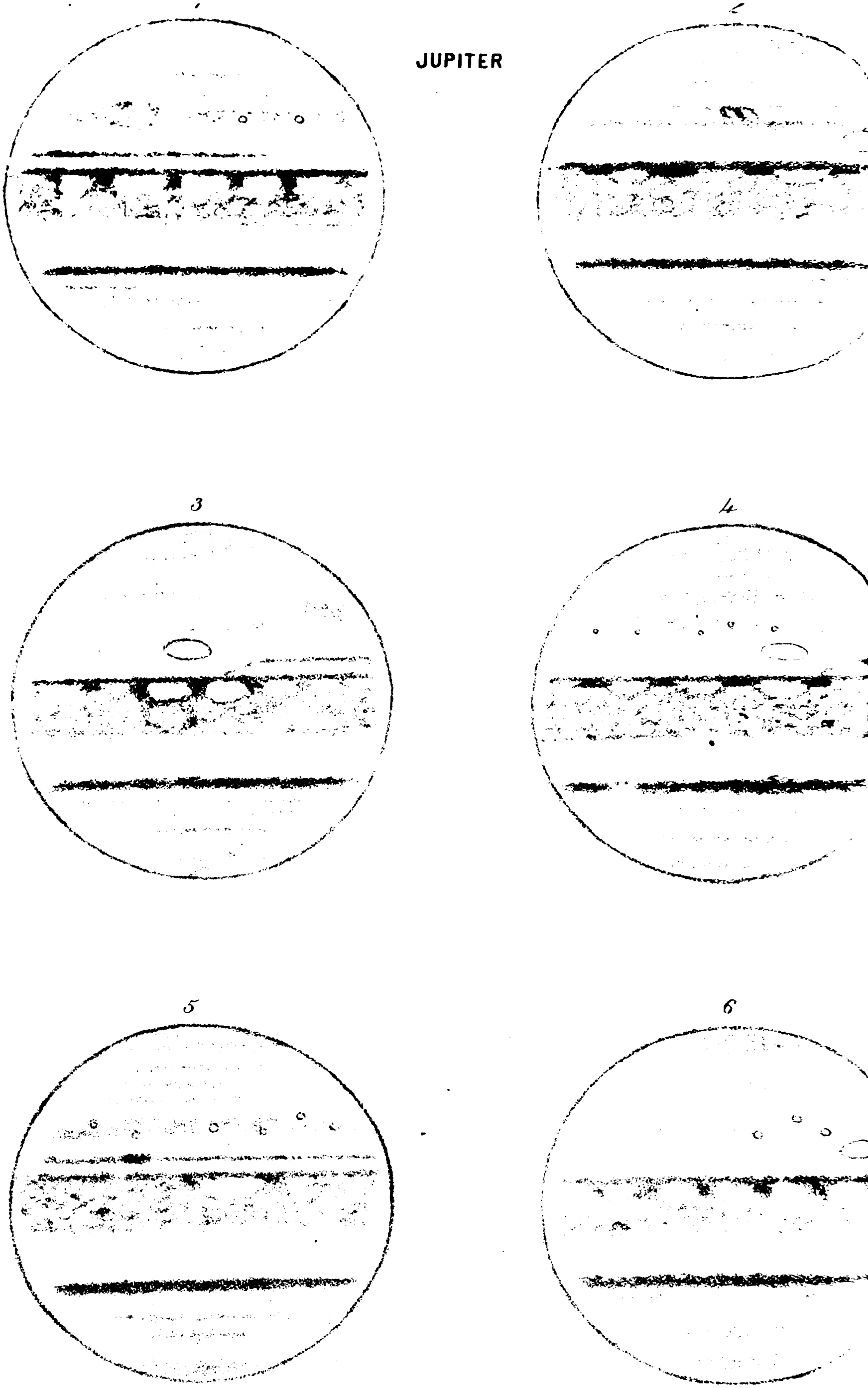
We are obliged to defer several interesting papers for want of space.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

JUPITER



1 Jan 25th 1870 $7^h\ 15^m$ G.M.T.
2 „ 23rd „ 7^h „ „
3 Nov 25th 1869 $11^h\ 15^m$ „ „
4 „ „ „ $10^h\ 30^m$ „
5 Dec 21st „ $11^h\ 10^m$ „
6 Nov 30th „ $12^h\ 15^m$

The Astronomical Register.

No. 107. NOVEMBER. 1871.

NOTES ON THE WONDERS AND BEAUTIES OF THE STARRY HEAVENS.

By C. Grover, Assistant to John Browning, Esq., F.R.A.S.

No. 4. THE CONSTELLATION LYRÆ.

About 2½° north-east of Vega, we find a small star, which is perhaps better known and oftener observed than many of the greater lights of the firmament. This is Epsilon Lyræ, generally rated as of the 4th magnitude, but owing to its proximity to the brilliant α, it appears of considerably smaller magnitude. This simple effect of contrast is particularly apparent on some of our dark winter nights, especially if we compare our object with a few other stars, registered as of the same magnitude, but situated in parts of the heavens far removed from any brilliant neighbour.

Attentive examination shows something about this star quite sufficient to attract attention, in fact, the naked eye shows this star irregular, elongated or notched, and, in the case of some few persons, gifted with visual organs of exceptional power, even separated; this is, however, but rare, and the amateur, who can distinctly elongate this star without optical aid, has no reason to be disappointed; the smallest telescope, or even an opera glass, shows it as a widely separated and nearly equal pair of stars, known as ϵ^4 and ϵ^5, Lyrae, ϵ^4 being the most northerly star of the pair. A moderate increase of optical power suffices to exhibit each of these as a very interesting and neat pair, thus constituting what is familiarly known as the double-double or quadruple star in Lyræ, discovered by Herschel, in 1779.

The observer will at once remark the points of resemblance between these two pairs, the components of E^4 being 5 and 6½, and those of ϵ^5 5 and 5½ magnitudes respectively. There is also an absence of the strongly

contrasted colours which characterize many of the compound stars, the tints of ϵ^4 are given as yellow and ruddy, and the components of E^5 are both white, in fact many a casual gazer would overlook the existence of colour altogether. The distances are given as 3″ 2 and 2″ 6 for ϵ^4 and ϵ^5 respectively. So that we have here the spectacle of two pairs of stars situated within 3½′ of each other, and with so many other points of resemblance as to strongly indicate the probability of some nearer connection than mere optical juxtaposition.

Micrometrical measurements have not only demonstrated the fact that such connection does exist, as evidenced by a continual change in the angular position of each pair; but, what is still more worthy of note, have shown that this motion is the same in direction in both cases, the motion being retrograde. From a discussion of the measures of various obververs, we find that in 75 years ϵ^5 (the most southern pair) has described an arc of about 28°, and in the same interval ϵ^4 has moved through about 16°, which a little calculation will show gives a period of 1000 and 2000 years respectively, supposing the movement to be continued uniformly, a condition of things, which in this case seems to be very likely of fulfilment, since in the period just referred to, the distances of both pairs have remained nearly unaltered. Clearly showing that their plane of motion must be nearly at right angles to the visual ray, and, therefore, that in this particular case, we observe the movements really as they are, without the complications unavoidably introduced when the inclination of the orbit to the visual ray, or excentricity of the orbit itself, required it to be allowed for. There appears to be but little doubt that both these pairs are linked together by some mysterious bond, and are slowly revolving around some grand centre, the position of which is at present unknown, and the period of whose vast cycle we are at present unable to comprehend.

These objects are rendered still more interesting from the presence in their immediate vicinity of several much smaller stars, much looked at by amateur observers, as tests of the light-grasping power of various telescopic apertures, one of these is very easily seen forming a triangle on the following side of the two doubles; preceding this, and situated on either side of a line joining the two pairs, are two much fainter stars, constituting the celebrated "Debilissima" couple, of Sir J. Herschel, and by him rated 13th magnitude. They are much brighter than this at present, and the late Rev. W. R. Dawes' estimation, giving them 10½ magnitude, is probably much nearer the mark, though few observers will be able to see them easily as Mr. Dawes did with a 3¾ achromatic, and they may be considered as about the limit of such an aperture. It is worthy of note that both these authorities class them as of equal brightness, but a very little attention will show a very perceptible difference; this has been noticed by the Rev. T. W. Webb, who, however, does not tell us which star takes the lead. I found the difference very noticeable in 1867 with a 6½ inch silvered glass reflector, and from not being able to always perceive them with equal distinctness, I have been inclined to suspect them of variation. The following extracts from my notebook are inserted as examples of the changes observed:—1867, May 19th. The two stars very unequal. N.F. the brighter by fully half a magnitude. June 10th. South Preceding star the brighter, when a stop is applied to the 6½ speculum which extinguishes the North Following star, the other is still visible. June 29th. N.F. star the brighter by ½ magnitude. August 23rd. S.P. star the brighter by ½ magnitude. Such changes as these, alternating with nights on which these two stars are so nearly equal that the difference is scarcely perceptible, are certainly very interesting, and I regret that I have not been able to devote more atten-

tion to their variations. I have looked at them occasionally since the above dates with the 12¼ speculum, and with the same results, sometimes one and sometimes the other being the brighter; and here there could be no possibility of deception, since the two stars are both visible in the same field of view, and, therefore, form an excellent check on each other. They are also equally liable to be affected by whatever atmospheric conditions prevail at the time of observation, added to which, they are such conspicuous objects with this aperture as to become visible in broad twilight. As soon as the sun is sufficiently below the horizon as to allow the naked eye to detect Vega, and long before ϵ itself can be discovered by the unaided sight, I have often seen these two little stars in the field of the telescope. Preceding the pair just mentioned, are three other small stars, forming a triangular figure; the star forming the southern angle being the smallest. Contrary to what is observed of many other celestial objects, these stars are best seen with a considerable magnifying power; an achromatic eye-piece, giving a power of about 450, shows them admirably.

We have still to add another star to this remarkable group. A minute point of about the 15th magnitude lies to the north of the North Following star of the Debilissima, and about one-third the distance between this and E^4. This star is just visible with a 6¾ inch speculum, and may be taken as the smallest star to be distinctly seen with such an aperture.

This addition, bringing up the number of stars composing this group to eleven, concludes our present notice. Nevertheless, it is evident that, especially as regards two of this number; we have yet much to learn. Therefore, continued and careful observations are very desirable, and would probably lead to most interesting results.

REVIEW.

A Chart of the Northern Hemisphere on an equal surface projection, with a Key made by R. A. Proctor, B.A., F.R.A.S.

A. Brothers, Manchester.

Some idea of the amount of pains and labour bestowed upon this extraordinary map may be gathered from first paragraph of the explanation:—"In this chart there are 324,198 minute dots, and each of these dots represents a star. Each star has been copied in with careful attention, both to position and size, from Argelander's splendid series of star charts. The present chart is intended to bear the same relation to Argelander's series of charts, that the maps of the hemisphere in an ordinary atlas bear to the maps of the several countries. The forty charts of Argelander's series we have included in a single chart, on a scale very much reduced, of course, but in such a way as to show the laws according to which the stars, down to the 9-10th magnitude are distributed over the northern hemisphere."

The chart is especially intended to show where the stars are richly and where sparsely strewed on the celestial vault. Before the work of star charting commenced, the surface covered by the chart was divided into 26,400 spaces, answering to the corresponding spaces in Argelander's series of charts. Into these spaces the stars were carefully copied—the time occupied in the work being 400 hours.

To make a comparison with the work of others, the Herschels in their gauges counted but 160,000 stars, while Struve dealt only with 31,000. This chart includes 324.198 stars.

Mr. Proctor announces that he is about to publish a treatise upon the lessons to be learnt from the chart, which we shall be glad to see.

We cannot do better than conclude this notice with the author's concluding remarks :—"To the general student of science, the chart is chiefly of use in affording the means of enlarging his conceptions respecting the glories of the celestial depths. If he remembers that every one of the dots in the chart represents in reality a sun—a sun, perhaps, exceeding our own in magnitude and splendour, he cannot fail to be impressed with the grandeur of the stellar universe. More than a hundred times as many stars as he can see on the darkest and clearest night are here represented. While the student of astronomy remembers that if his powers of vision were so increased as to command the same range as Argelander's telescope (2¾-in. in apert), he would see each night as many as are shown in the photographic chart; let him further consider that a hundredth part of the celestial vault would exhibit, under the power of the Herschelian gauging telescopes, as many stars as are shown in the whole extent of the present chart. Even this enormous increase is but little, compared with that which would result could the powers of Lord Rosse's great mirror be applied, and *nothing* by comparison with the real number of luminaries which exist amid the depths of space."

It is not a little curious that some of the spots most barren of stars are the very borders af the milky way.

We were unable, through press of matter, to print the two following important letters last month, which will doubtless be wanted for future reference.—Ed.

FUTURE SOLAR ECLIPSES.

Sir,—The important physical observations which have been made during recent total eclipses of the sun have invested these phenomena with an interest independent of that attaching to the striking appearance in nature witnessed on these occasions, which have so frequently formed the subject of wonder and admiration in past times. I am thereby induced to send you a brief notice of the total eclipses which will occur during the next twenty years, founded upon a series of calculations undertaken for my own information, and very recently completed. I shall avoid introducing numerical results to any extent, and trust to verbal description as affording a sufficient guide to the course of the moon's shadow over the surface of the earth in each eclipse. I shall endeavour, also, to indicate the localities in which observations may be made with the greatest advantages. One or two eclipses, where the apparent diameters of sun and moon will be so nearly equal as to unfit them for favourable physical observation, will be omitted.

The eclipse of the 12th of December next is described generally in the various ephemerides. It will be total in Southern India and in Ceylon in the early morning. At Ootacamund, the sanitary station in the Neilgherry Hills, for 2m. 8s., totality commencing at 7h. 32m. 53s. a.m., local mean time, with the sun 18 degrees above the horizon. The first contact of limbs occurs here a quarter of an hour after sunrise, so that the whole eclipse is visible. At Trincomalee totality commences at 7h. 55m. 45s. a.m. local time, and continues 2m. 11s. In the northern part of the Australian continent the eclipse may extend over more than four minutes. Expeditions are organizing for several stations along the

central line. In the Neilgherries, in particular, it appears favourable weather is confidently expected. I remark upon other eclipses in order of date :—

1. The eclipse of 1874, April 16.—The central line commences in the Antartic Regions, near the position marked upon our charts as "Weddell's farthest," and crosses Southern Africa, from the Orange River district to Natal. The only locality in which observations could be advantageously made lies between the Orange River and Lion mountains, near the west coast, in about 29 degrees south latitude. Taking as a point for special calculation 18 degrees E., 29 degrees, 11 minutes S., I find the last ray of sunlight disappears at 3h. 53m. 54s. p.m. local time, and totality continues 3m. 37s., the sun at an altitude of 22 degrees ; this point is very near the central eclipse. On the eastern coast the sun's elevation is less than ten degrees ; at Port Natal he is obscured for 50 seconds only, but some 75 miles further north the total eclipse may extend to nearly three minutes. At the Royal Observatory, Cape of Good Hope, there is a very large partial eclipse, the greatest phase at 3h. 50m. p.m.

2. The eclipse of 1875, April 6.—The greater part of the central line rests upon the Indian Ocean, from Madagascar, in a north-easterly direction, but it will traverse Further India (British Burmah) and Siam, and the totality may be very favourably observed in this region, the sun being high in the heavens. At Mergui he is obscured 4m. 6s, at Tenasserim 2m. 48s., and at Ban-kock 3m. 19s. At Mergui, which is near the centre of the shadow, the sun disappears at 1h. 59m. 40s. p.m., while at an altitude of 60 degrees.

3. The eclipse of 1876, September 17.—The total phase commences a little below the equator, north of New Guinea and passes over the Pacific to the south-west of Cape Horn ; it appears to escape all the principal islands ; in 175 degrees W. the duration is 1m. 40s., which is nearly the *maximum*. The phenomenon does not promise to be of utility to the physical astronomer.

4. The eclipse of 1878, July 29.—The belt of totality runs from the mountains north of Nertchinsk, in Siberia, over Behring's Straits, British Columbia, the Western States of America (Colorado, Texas, &c.,) and by Havannah to Port-au-Prince, Hayti, near which point it passes off the earth. In 135 degrees 30 minutes W., and 59 degrees 30 minutes N., where the sun will be near the meridian, the duration of total eclipse is 3m. 6s. ; at Denver, Colorado, 2m. 47s. ; at Havannah, 1m. 53s. ; and at Port-au-Prince, 1m. 24s. ; but here the sun is less than 5 degrees from the west horizon. This will be the fourth return of the great eclipse of 1806, which was also visible in the United States.

5. The eclipse of 1882, May 17.—The central line commences in the Ashantee territory, traverses Africa to Upper Egypt and the extremity of the Sinaite peninsula at the entrance of the Gulf of Akabah ; the duration of totality here is rather less than two minutes. The after course is by Teheran and Kashgar, across the Chinese Empire to Shanghai, where the eclipse is total for 20 seconds only; with the sun 18 degrees high.

6. The eclipse of 1883, May 6.—The central line commences in 156 degrees E., about 35 degrees S. of the equator, and passes below Norfolk Island, the Friendly Islands, and among the Marquesas, ending in about 87 degrees W. and 14 degrees S. Its course is, therefore, a very unfavourable one for observations, being a sea-track almost throughout. If any station is found, it may probably be between 150 degrees and 160 degrees west longitude. In the longitudes of the Marquesas, the sun may be observed 5m. 15s.

7. The eclipse of 1885, September 9.—Begins at sea, east of Tasmania,

and is total in New Zealand in the southern part of the Northern Island. At Wellington totality continues only 40 seconds, the sun disappearing at 7h. 42m. 22s a.m., at an altitude of 15 degrees; but some 35 miles further north, it may extend over nearly two minutes. The south latitude of the central line afterwards increases until it passes off the earth within the Antarctic Circle. New Zealand will, consequently, be the only available station in this eclipse.

8. The eclipse of 1886, August 29.—As regards the length of duration of totality, this will be the most notable phenomenon within the period of which I am writing. The central line commences among the more southerly of the Bahama Islands, and, traversing the Atlantic, meets the coast of Africa, near Portendik, leaving this continent on the eastern side, south of the equator, and ending 2 degrees north of the upper extremity of Madagascar. Calculating for a point on the West Coast of Africa in latitude 17 degrees 55 minutes S., which is about ten miles south of Portendik, and close upon the central line, I find the total eclipse commences at 11h. 27m. 36s. a.m., local time, and continues 6m. 21s., the sun being at an altitude of 79 degrees.

9. The eclipse of 1887, August 19.—Frequent reference has been made in astronomical works to this eclipse, on the assumption that the line of totality would reach England. This, however, is now known to be an error. The central line begins at Bernberg in Anhalt, passes near Wilna and across Russia to Perm, thence by Tobolsk and rather north of Irkutsk to Manchouria, and over Japan in about 38 degrees N., to the Pacific, where it ends in 174 degrees E., and 24 degrees 30 minutes N. The duration of totality at Wilna, one of the most westerly points at which the sun can be well seen, is 2m. 15s., but on the shores of Lake Baikal, where he is nearly on the meridian, it may extend to 3m. 40s.

10. The eclipse of 1889, December 22.—Commences in the Carribbean Sea, and, passing over Barbadoes into the Atlantic, arrives on the African Coast in Angola, thence traversing Lake Tanganyika, it continues its course to the Indian Ocean, and leaves the earth in about 61 degrees E., and 7 degrees N. At Bridgetown, Barbadoes, totality begins at 6h. 47m. 6s. a.m., with the sun at an altitude of 6 degrees, and continues 1m. 48s. On the Angola coast in 10 degrees south latitude, he is 56 degrees above the horizon, and is obscured 3m. 34s., the middle of the eclipse falling at 2h. 11m. p.m. local time.

This completes the list of total eclipses which will be available for physical observations during the next twenty years. In one or two cases, however, it will be seen that such observations may be attended with great difficulties.

I am, Sir, your most obedient servant,
Mr. Bishop's Observatory, Twickenham: J. R. HIND.
Sept. 6. —*Times.*

THE APPROACHING TOTAL SOLAR ECLIPSE IN INDIA.

Sir,—It may interest your readers to know that owing to the prompt liberality of the Government in India, Colonel Tennant, R.E., F.R.S., has had placed in his hands sufficient funds for instruments, and for covering all the charges of an expedition to the South of India for observations of the total eclipse of the sun on the 11th of December. Through Lord Mayo's kind personal interference, Colonel Tennant, who had just been appointed to the charge of Her Majesty's Mint at Calcutta (in the absence of the Master), has received permission to superintend the expedition in person.

He will be assisted in observations with the spectroscope by Captain Herschel, R.E., F.R.S. The photography will be undertaken by Mr. Hennessey, of the Great Trigonometrical Survey. In addition to these gentlemen, Colonel Tennant has the promise from Major Montgomerie (acting for Colonel Walker) of two trained assistants. The observations will be made at the old meteorological station of Dodabetta, lat 11° 25′ 5″ N. long. 76° 43′82″ E., which is on one of the highest peaks of the Neilgherries, 8,650 feet above the sea.

Colonel Tennant will be well provided with instruments most suitable for a spectroscopic examination of the phenomena of the eclipse and for the delineation by photography of the outer portions of the corona. It may be mentioned that the Astronomer Royal, with the sanction of the Admiralty, has granted the use of one of the 6-in. equatorials, constructed by Messrs. Simms for the observations of the transit of Venus.

The great skill which Colonel Tennant and Captain Herschel exhibited in their very successful observations of the total eclipse of 1868, and the experience in the observation of so exciting and temporary a phenomenon as a solar eclipse which they then gained, together with the perfect acquaintance of these gentlemen with the subsequent observations of the eclipse of 1869 in America, and that of last December in Europe, and, consequently, with the special observations which are now most needed for the increase of our knowledge of the nature and extent of the sun's surroundings, justify the most sanguine expectations as to the great value of the new information we shall gain from this expedition.

WILLIAM HUGGINS.

Upper Tulse-hill : August 19. —*Times.*

We hear from *Nature* that the arrangements of the Eclipse expedition are nearly all made, and that the numbers are now complete. The expedition sails on Thursday the 26th in the *Mirzapore*, arriving at Point de Galle on the 27th November, if all goes well. M. Janssen, we believe, is already *en voyage*. Professor Respighi, of Rome, will accompany the English expedition.

The Madras Government have sanctioned an advance of 2,000 rupees being part of the expenditure on account of their assistant astronomer who is to proceed to England, in order to undergo the necessary training in celestial photography. He is to return to Madras, fully primed, in December next, in time for the total eclipse of the sun, which is to take place on the 12th of that month, and will be prepared to take photographs of the different phases of the phenomenon. *Times of India.*

DEATH OF MR. BABBAGE.

The death is announced of Mr. Charles Babbage, who has long held high rank amongst the mathematicians of the day. He was, with Herschel, one of the founders of the Royal Astronomical Society. He was born on December 26th, 1792, and was educated by the Rev. Stephen Freeman, of Forty Hill, Enfield, Middlesex, from whom he imbibed his intense love of mathematics, one of his schoolfellows being the late Captain Marryat, the novelist. He proceeded to Trinity College, Cambridge, where he took his B.A. degree in 1814, but curiously enough his name does not appear in the mathematical tripos. In the course of his mathematical studies he

found fault with the logarithmic tables then in use as being defective and unfaithful, and in order to improve them visited the various centres of machine labour in England and on the continent, and on his return directed the construction of a "difference engine," for the use of the government. Another result of this tour was the production of his work on the "Economy of Manufactures." By 1833 a portion of his machine (popularly known as "The Calculating Machine") was prepared, and its operations were entirely successful. It was, however, never completed. He next prepared his "Tables of Logarithms of the Natural Numbers from 1 to 108,000," a work which was so highly esteemed that it was very soon afterwards translated into almost all the European languages. In 1811 Mr. Babbage was elected Lucasian Professor of Mathematics, an office which had been filled by Sir Isaac Newton, Dr. Isaac Barrow, Bishop Turton, Professor Airey, and other eminent persons. This post he resigned in 1811. Amongst his most prominent works may be mentioned "A Ninth Bridgwater Treatise," the design of which was to show the error of a supposition implied in the first volume of that celebrated series, that ardent devotion to mathematical studies is unfavourable to religious faith. Mr. Babbage once, and it is believed once only, sought political honours, having become in 1832 a candidate for the borough of Finsbury, in the advanced Liberal interest, but was not successful. He was a Fellow of the Royal Society, and a member of a large number of literary institutions.—*Standard.*

THE SUN'S PARALLAX.

Is there nobody who will perform an act of justice and ask those, who seem to have never known or to have forgotten my doings, to be kind enough not to deprive me of my just claims? When, A.D. 1857, my old method of determining the sun's parallax was again publicly proposed, I thought it somewhat strange and wondered what could be the reason, that it should be treated as if it were some new and not a very old acquaintance of science. When, some time later, a stir was made about what was represented as a new method of investigating the motion of the solar system in space, and, instead of a new, there was brought forward an old acquaintance (known to science since the times of your grandfathers), only dressed anew and engaged to perform some truly "astounding" antics, I wondered indeed that no friendly hand should have prevented such an exhibition, but I also comprehended the true state of affairs. And, since then, I have had to shrug my ghostly shoulders so often, when learning further news about your curious knowledge of science, and your strange opinions, and your queer notions of honour and justice and fairness, that I have long ceased to wonder at anything some of you may say or do. However, as it is only right that I should be allowed to retain what belongs to me, and as nobody appears to remember my claims, you will probably raise no objection, if I myself enlighten you a little and remind you, how, A.D. 1672, I determined the sun's parallax.

Read in the history of my life [Bailey's Account, etc., p. 32]. "Whilst I was enquiring for the planets' appulses to the fixed stars by the help of Hecker's ephemerides, I found that, in September, 1672, the planet Mars, then newly past his perihelion and opposition to the sun, would pass amongst three contiguous fixed stars in the water of *Aquarius:* and that, by reason he was then very near the earth, this would be the most convenient opportunity, that would be afforded of many years, for determining his, and consequently the sun's horizontal parallax. I drew up a *monitum* of this appearance, and sent it with a letter to Mr. Oldenburg, who printed

it in his *Transactions*, No. 86, August 19th, 1672: having before sent my admonition into France, where the gentlemen of their Academy took care to have it observed in several places. My father's affairs caused me to take a journey into Lancashire, the very day I had designed to begin my observations; but God's Providence so ordered it that they gave me an opportunity to visit Townley, where I was kindly received and entertained by Mr. Townley, with whose instruments I saw Mars near the middlemost of the three adjacent fixed stars. My stay in Lancashire was short: at my return from thence, I took his distances from two of them at different times of the night. Whence I determined his parallax, then 25″, equal to his visible diameter; which, therefore, must be its constant measure; and, consequently, the sun's horizontal parallax not more than 10″. This I gave notice of in the *Transactions*, No. 96; and the French, soon after, declared that from their observations they had found the same. Whether they will give such exactness, I leave to those who are skilful in these things to determine."

This extract is, I hope, sufficient, and I will leave it to you to search further. Perhaps you may consider my language a little quaint; but then, remember, I lived two centuries ago.

Now, the planet Mars performs 109 sidereal revolutions in 205 sid. years and $3\frac{1}{4}$ days, so that its appearance in the year 1877 will not be much different from what it was in 1672. Accordingly, I enjoin you to make then the most of your opportunity, and do your best to prove the goodness of my old method, and I wish you thorough success. And, when you watch the planet pass amongst the stars in the water of Aquarius, you will, perhaps, remember with kindly feelings an old astronomer, who in life had to endure great injustice and sore trials, and will bless and honour his memory.

Walhalla. THE GHOST OF JOHN FLAMSTEAD, M.R.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

JUPITER IN OCTOBER, 1871.

Sir,—A few notes on some objects now visible on the disc of this planet will probably be read with interest by some of your readers. The lithographs will aid in the identification of the regions described.

October 9th, 1871. About 4 a.m., the air being very still and the sky quite free from cloud, a tolerable sketch was obtained. The equatorial bands and the region between appeared to be much the same as last year. No. 5 was well seen, and also two similar faint belts to the S. of it. No. 2 was the finest band on the disc, as has been the case for some years. No. 1 was also well seen: on it were two dark oblong spots, one being in the centre, and the other a little to the E. Above (to S.) the central spot, and in contact with the under edge of No. 2, was also a dark spot. But the most noteworthy object was a large spot lying in the bright zone between bands 2 and 3, and touching both of them. It was not very dark, nor yet well defined. It was seen again on the 11th October, about 4.30 a.m., but no better view was then obtained.

The festoons under No. 4 are again to be seen.

Mr. Edward Crossley's Observatory, Park Road, Halifax.

I am, Sir, truly yours,
JOSEPH GLEDHILL, F.G.S.

JUPITER.

Sir,—On February 20th of the present year, at 7.30 p.m., I turned my telescope on Jupiter, and was surprised to find the belts presenting quite an unusual appearance. All the equatorial belts were broken up into distinct masses of clouds, there being about four irregular parallel rows, each containing about five distinct and separate cloud-masses. Higher powers brought out this unusual scene most magnificently. A statement of this observation appeared in the Report of the O.A.S. to May 31st, 1871, and since then I have been anxiously waiting for it to be corroborated by other observers.

No other notice of the appearance of the planet on the above occasion has, however, appeared, and thus an important and almost unique phenomenon is unrecorded by a second observer. As it is impossible to imagine Jupiter not to have been scrutinized by others on the above date, I send this in hopes that some of your courteous correspondents may corroborate this interesting appearance, and possibly amplify it by the aid of larger instruments.

Yours faithfully,
ALBERT P. HOLDEN.

Hoxton Street, N.
Sept. 19th, 1871.

ARE HIGH POWERS THE BEST FOR VIEWING FAINT STARS?—MOONLIGHT NIGHTS.

Sir,—I have lately read some letters in a weekly paper (partly devoted of Astronomy), as to whether high or low powers, on moderate apertures to, say three or four inches, are the best suited for viewing faint stars; and as some difference of opinion seems to exist on this subject, I should be glad if this matter were a little "ventilated" in your able *Register*.

As far as my experience goes for viewing stars of the 11th and 12th magnitudes, I am decidedly in favour of using powers under or near 100 in preference to those above that figure.

My own refractor of 4½-inches shows the "Comes" to *A. Lyræ* very easily with an eye-piece of about 70 times, but becomes a difficult object if magnified much over 100 times; and this applies in some degree to the companion to *Polaris*, which, by-the-by, I always think can be seen quite as readily in the brightest moonlight as when our Luminary is absent. I have often doubted whether it is correct to fancy that *the moon must be absent* to enable an observer to see such and such stars; my own impression is that many moonlight nights are wonderfully clear and transparent. Will some obliging correspondent kindly instruct one who prefers light to darkness?

I remain, yours faithfully,
WM. L. LANCASTER.

St. Aubin's Lodge, Hackney Downs:
21st October, 1871.

THEORIES.

Sir,—The common saying, "a miss is as good as a mile," received a happy illustration on the 26th July, when Mr. J. B. Smith's motion in the House of Commons, for abolishing all our existing weights and measures, and compelling the universal employment of the French or metric

system, was negatived by the narrow majority of five. An excellent leading article on the subject in the *Times*, of the 27th of July, (in which the Parliamentary discussion also appeared,) deserves to be re-printed and widely circulated. Attention may also well be called to the late lamented Sir John Herschel's paper, entitled "The yard, the pendulum, and the metre," in his *Familiar Lectures on Scientific Subjects.*" Had the metric advocate succeeded, the wide-spread confusion, annoyance, and loss, described by the *Times*, would, in all likelihood, have speedily compelled the reversal of a measure, that has been proved to be untenable in a scientific, unsound in an economic, and undesirable in a social point of view. *Pace* its advocates,—some of whom are men of mark,—bad luck to their crotchet, if ever it shall be again brought forward! The fifth Report of the Standards Commission, of which our Astronomer Royal is a member, was given in the *Times* of July 28th.

Passing to another subject, Sir William Thomson, in his interesting inaugural address, at the recent meeting of the British Association, in Edinburgh, said: "We must regard it as probable in the highest degree, that there are countless seed-bearing meteoric stones moving about through space. If at the present moment, no life existed upon this earth, one such stone falling upon it might, by what we blindly call natural causes, lead to its becoming covered with vegetation. The hypothesis that life originated on this earth, through moss-grown fragments from the ruins of another world, may seem wild and visionary; all I maintain is that it is not unscientific." And, just before, the President observed: "Should the time when this earth comes into collision with another body, comparable in dimensions to itself, be, when it is still clothed as at present with vegetation, many great and small fragments carrying seed, and living plants and animals, would undoubtedly be scattered through space." A sensible and amusing article on this subject appeared in the *Times* of August 7th. It is a supposition which decidedly improves upon Monsieur Trissotin's notions, two centuries ago:

" Je viens vous annonces une grande nouvelle,
Nous l'avons en dormant, madame, échappé belle.
Un monde près de nous a passé tout du long,
Est chû tout au-travers de notre tourbillon ;
Et, s'il eût en chemin rencontré notre terre,
Elle eût été brisée en morceaux comme verre."*

An hypothesis, however, from a man of Sir William's eminence, cannot but be deserving of attention, formidable as may seem the difficulties in its way. For instance, as to the "moss-grown fragment," would not the heat produced by its passage and impact be likely to destroy vegetation? And, in the case of a fragment of some considerable size, carrying not only seed, but living plants and animals, the chances against its safe arrival appear to be immensely multiplied. Before a body at all comparable in dimensions to the earth could come in collision with it, there would be a tidal action, productive of disastrous effects: and, if the collision itself were such as to shatter our globe, and not merely produce an amalgamation, who can predict the series of terrible results? The heat generated by the impact,—the liberation of internal heat by the fracture, —the escape of molten matter and deadly gases,—electric phenomena on an unknown scale. And, supposing, nevertheless, that a fragment got off

* . Moliere. *Les Femmes Savantes.* Acte iv. Sc. III.

from such a "crash of worlds," carrying some animal and vegetable life on it, what would be likely to become of that life, in its passage to another world? The inclination of the axis of the fragment, and its rotatory velocity, probably differing considerably from the earth's, the seasons, days and nights, would be suddenly altered; the portion of atmosphere it took with it, dilating by reason of the small gravity, would bring about a serious change in density and temperature; to say nothing of the inconvenience of the immense and sudden increase in the muscular power of animals, proceeding from the same cause.

But, supposing some animal and vegetable life to survive these and probably other dangers besides, there would finally have to be encountered those attending on the arrival of the fragment at some other globe: a shock which, under the most favourable circumstances, could not be trifling. And, moreover, the air, water, and meteorological conditions of this other globe must needs not be very different from our own, in order that, after all, its newly imported fauna and flora might not perish almost as soon as it arrived. If it be difficult, and often impossible, to acclimatize plants and animals in foreign regions, in this world, what must we think, apart from dynamic considerations, of the difficulties attendant on their transport through vast regions of space to some other? The president said: "I am fully conscious of the many scientific objections which may be urged against this hypothesis, but I believe them to be all answerable." We must, therefore, be content to wait a little for elucidations, for which his long and valuable discourse could not afford space.

In regard to the mighty mystery of life itself, it is pleasant to read Sir William's remarks; especially to those who have not ceased to value and revere, as doubtless he does himself, a still more "excellent old book" than *Paley's Natural Theology*, to which he made reference. Of that transcendent mystery, indeed, we know, and are as likely to know, as little as ever. Its origin is as much veiled to our modern science, as it was to Epicharmus, in the beautiful mythic fable, by Alex. Von Humboldt, called "The Vital Force, or the Rhodian Genius." Sir William Thomson, well termed the belief "that life proceeds from life, and from nothing but life," an "article of scientific faith, true through all space, and through all time."

I am, Sir, yours, &c.
GEORGE J. WALKER.

BERTHON'S NEW DYNAMOMETER.

Sir,—Such of your readers as have hitherto trusted to the estimation given them, by the makers, of the power of their eye-pieces, will, no doubt, be very pleased to hear that they can now, at a very trifling expense, prove for themselves whether these estimations are accurate or not. Even the best telescope makers occasionally indulge in over-statements of this nature. The Rev. E. L. Berthon, F.R.A.S., well known as the inventor of many scientific instruments, has at length produced a Dynamometer, which, for accuracy, vies with the older sorts, and for cheapness leaves them far behind. I have tested it with ten eye-pieces, and found the results in each case very accurate indeed. The instrument consists essentially of a brass scale, by which is read the exact diameter of the

luminous image of the object glass, or large speculum. The instrument reads to ·001 of an inch ; as it is divided by machine, it may be fully relied upon for accuracy.

The maker, Mr. Tuck, of Romsey, will, doubtless, be happy to give every information to intending purchasers.

Yours faithfully.

F. W. LEVANDER, F.R.A.S.

Barnsbury : September 13, 1871.

CLEAR NIGHTS.

Sir,—When I commenced keeping a meteorological register, in 1849, it appeared to me that a record of the clear nights might be of some interest to myself and others, as indicating the astronomical value of the climate of Hull ; and, although I made this a somewhat prominent point in a paper on the meteorology of Hull, read before Section A of the British Association, at its meeting in this town, in 1853. I was not aware, until I saw the communication of Mr. Johnson in this month's *Register*, that any other observer had included a clear night column in his register, an omission that always caused me some surprise and regret; inasmuch as it seemed to me, that such a record would be of service in pointing out the best site for any large telescope, similar to that of Mr. Newall's; and, I may further remark that if such records were also kept at all observatories, magnetical as well as astronomical, we should then probably possess a tolerably reliable register of the most favourable astronomical sites in the civilised world; and, here permit me to point out, that such a register as I am advocating already actually exists from necessity in the journals of all astronomical observatories, and only requires extracting. For instance, all those nights in which the memoirs of the observatory showed general observations had been made, would be clear nights at that time and place.

My interpretation of a clear night is the same as Mr. Johnson's ; that is, clear up to or for some hours before midnight; but, it must not be understood that all the nights in the accompanying table were really good telescopic nights (many of them were found to be so from the writer's experience) ; they represent nights cloudless, or nearly so, to the hours above named, and which would be more or less available for telescopic uses, according to the amount and direction of the wind, moisture in the atmosphere, &c.

If you can allow the space, I shall be glad to see further contributions (tabular results) on this subject, particularly from West Yorkshire or some of the Midland Counties—say Nottingham, which latter county I am inclined to think will be found to possess a more favourable astronomical climate than either Devonshire or East York. They will at least be free from a phenomenon peculiar, I believe, to the east coast, known as the sea fog or sea reek, but which seldom in this locality extends over 20 miles inland. It chiefly prevails during the nights of the summer months, when a very hot and calm day is succeeded by an easterly wind, at or about sunset.

Yours truly,

WILLIAM LAWTON.

Hull: August, 1871.

Clear Nights.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1849		6	7	8	8	15	14	3	6	12	13	9	101
1850	3	16	14	14	11	10	10	18	13	15	15	8	147
1851	11	14	12	12	12	16	4	13	12	10	15	7	138
1852	13	12	9	19	10	6	15	10	18	12	8	8	140
1853	14	5	15	5	14	11	7	7	9	5	13	7	118
1854	8	9	12	16	9	5	6	9	8	14	12	5	113
1855	4	4	6	11	9	8	6	6	9	7	3	7	80
1856	11	3	8	8	3	10	10	7	6	2	9	9	86
1857	7	6	7	5	7	11	12	6	10	6	6	9	92
1858	13	15	10	14	2	11	9	9	3	4	8	11	109
1859	8			8	16	4	5	10	8	9	7	7	82
1860	6	7	6	8	6	1	3	4	6	9	3	3	62
1861	4	7	13	8	9	5	7	10	10	7	9	9	98
1862	6	4	5	8	9	5	4	9	10	8	10	6	84
1863	8	9	9	9	8	13	12	1	6	11	13	13	112
1864	6	11	12	12	7	9	10	16	16	7	6	6	118
1865	10	4	8	14	13	10	3	7	20	15	7	8	119
1866	10	10	5	12	14	9	10	4	12	7	11	8	112
1867	4	7	5	7	5	10	5	12	7	7	5	11	85
1868	4	6	9	9	18	18	9	14	8	13	2	6	116
1869	3	4	3	11	3	8	8	10	10	8	9	5	82
1870	13	0	7	11	10	8	0	4	6	10	12	5	86
	$7\frac{19}{21}$	$7\frac{12}{21}$	$8\frac{14}{21}$	$10\frac{9}{22}$	$9\frac{5}{22}$	$9\frac{5}{22}$	$7\frac{15}{22}$	8·13	$9\frac{15}{22}$	9	$8\frac{20}{22}$	$7\cdot\frac{13}{22}$	

VARIABLE STAR.

Sir,—My observations during the present year fully confirm a suspicion I entertained that Mr. Birmingham's fine red star in Cygnus, zone + 47°, No. 3,077 of the Bonner Sternverzeichniss, would prove to be variable. Projecting the observations on cross-ruled paper, I find that the star passed a *maximum* 8·05 mag. on June 16th, a result which may, however, be a few days in error. Further observations will be required to fix with precision the elements of the light-curve; but the period would appear to be about one year, with a range of not less than 1·3 mag.

The variable, which will I presume be U. Cygni, may be easily found 9′·4 *n.* 4m. 10s. *f.* the 5th mag. star 32 Cygni. Its colour is fine, and it has a bluish 8·3 mag. neighbour, which forms a useful star of comparison.

I am, Sir, yours faithfully,

GEORGE KNOTT.

Woodcroft Observatory,
Cuckfield, Sussex: Sept. 16th, 1871.

SIR J. SOUTH'S 8-INCH OBJECT-GLASS.

Sir,—Can any of your readers, who were acquainted with the late Sir James South, inform me who was the maker of the 8-inch object glass of the 12-feet telescope, which was mounted upon a huge wooden framework, in the grounds of Sir James's house, at Kensington? This instrument has come into my possession, and is a fine specimen of an early achromatic. I have been informed that, at the sale of Sir James South's instruments, this object-glass was attributed to Dollond, but is it not more likely to have been the work of the elder Tulley?

Estate Offices, Keele, I am, Sir, your obedient servant,
Near Newcastle, Staffordshire: H. W. HOLLIS, F.R.A.S.
August 24, 1871.

DESIDERATA.

Sir,—The difference in the performance of the clocks or timepieces recommended by your correspondent, "Habens," and such as I described in my letter to the *Register* of September last, is so palpable to persons who have any experience in the matter, that I cannot understand how any one can attempt to make a comparison, except it be through ignorance.

"Habens," in his letter in the August No., says—"*The above is a first-rate timekeeper;*" and again in his letter in this month's *Register*, speaking of certain library and drawing room clocks actuated by a spring, they are said to be of "*unimpeachable veracity.*" These terms certainly convey the idea of comparability to anything produced.

In conclusion, let "Habens" place his new sidereal clock beside a good *old* clock of even moderate pretensions with a 40-in. pendulum, driven by a weight and having a maintaining power and a "little month," if the experiment is fairly tried, will show the absurdity.

I am, Sir, yours, &c.,
JOHN G. ALLISON.

Whitburn, near Sunderland:
October 16th, 1871.

NEPTUNE.

Sir,—Will you permit me to return my sincere thanks to your correspondent, Mr. S. J. Walker, of Teignmouth, Devon, for his great kindness in forwarding to me a chart of the small stars surrounding Neptune, and also copies of his very valuable and interesting pamphlets on the Arabic names of the stars, &c. I saw Mr. Walker's letter in the last number of the *Astronomical Review,* in which he said that he would furnish a diagram showing the position of Neptune to those desirous of obtaining it. I wrote, asking him for one, and he sent me the kindly response I have mentioned.

As I am endeavouring to instruct my pupils in the sublime Science of Astronomy, I feel particularly grateful to Mr. Walker, and I wish to thank him publicly through your columns.

Faithfully yours,
CHARLES W BENSON, LL.D.

Rathmines School, Dublin:
16th October, 1871.

Δ CYGNI.

Sir,—I beg to hand you the following recent measures of δ Cygni, made with my 7½-inch Alvan Clark refractor, and a wire micrometer.

Aug. 10. $P=338^\circ{\cdot}72$ $D=1''{\cdot}875$
Oct. 12. $P=338^\circ{\cdot}06$ $D=1''{\cdot}633$
Oct. 13. $P=337^\circ{\cdot}72$ $D=1''{\cdot}637$

The distance at the first epoch is certainly too large. In my "Remarks" on that occasion, I have noted that the small star was only seen at intervals, and that the measures were very uncertain.

I am, Sir, yours faithfully,
Woodcroft Observatory, Cuckfield, Sussex: GEORGE KNOTT.
October 16th, 1871.

A METEOR.

Sir,—A meteor, the most brilliant I have ever witnessed, passed over Southampton last evening, precisely at nine o'clock, Greenwich time. It commenced in the tail of the Serpent, and travelled slowly downwards and to the westward, describing in its course a gentle curve. and passing through Ophiucus, finally disappeared below the horizon. In size it was apparently about four or five times as large as Jupiter. The colour was a beautiful violet tint, and reminded one of the effect produced when the metal potassium is burnt on the surface of water. It left a train of light behind which, notwithstanding the brilliancy of the moon, was clearly visible for several seconds afterwards. Possibly the same meteor might have been seen in different parts of England by other observers; if so, it would be interesting to compare notes, with the view of ascertaining the probable height.

I am, Sir, yours obediently,
Southampton: Oct. 2. W. B. S.
—*Standard.*

A BRILLIANT METEOR.

Sir,—I had the pleasure of witnessing a very brilliant meteor last evening, at about four minutes after nine. I was walking southward at the time, but its brilliancy caused me to turn round. It was then proceeding from the region of the Polar Star, passing close to δ and γ, and disappearing near χ in Ursa Major. It must have lasted several seconds, and changed in tint from pale blue to pink.

I am, Sir, yours obediently,
Earlswood, Red-hill, Surrey: WILLIAM WOOD.
Oct. 13. —*Times.*

A SUN-SPOT.

Sir,—A very remarkable spot is at present visible on the sun's disc. At nine this morning it measured 4 min. 20 secs. in length, or upwards of 114,000 miles. The penumbra, which was very narrow, contained three large umbræ and a great number of small spots.

I may add that the spot was easily seen at noon to-day with a small opera glass magnifying about three diameters.

I am, Sir, your obedient servant,
Bedford: October 12. THOMAS G. E. ELGER, F.R.A.S.

ENCKE'S COMET.

SIR,—With the assistance of Mr. Hind's ephemeris I was able to find Encke's Comet the first time I searched for it, last night, readily enough. The sky was hazy and luminous, and the light of the moon at her first quarter was unfavourable for seeing so delicate an object well. I found the comet to consist of a diffused nebulosity of extreme faintness, apparently circular; the diameter was by estimation as much as six to seven minutes of arc; illumination of the micrometer webs was out of the question, even with my large aperture of 18 inches. After long gazing I became convinced that the condensation, which was evident enough, was not central, but chiefly on the following side.

The approximate position of the comet at 9h. 4m. Greenwich meantime was:—right ascension, 22 min. 30 sec.; declination, north 38 deg. 34 min.

I am, Sir, yours faithfully,

HENRY COOPER KEY.

Stretton Rectory, Hereford: —*Standard.*
Oct. 21.

Mr Hind states that he believes that he re-discovered Encke's Comet on September 22nd. It was somewhat out of its predicted place.

A New Minor Planet, No. 117 was discovered on September 8th, 1871, by Dr. C. H. F. Peters, at Hamilton College, Clinton, U.S.

VARIABLE STARS.

1871.	G. M. T.* h	m.			mag.		Place of Star 1855. A. R. h.	m.	s.	Decl. °	′
Nov. 1			R Camelopardali	max.	7·2	...	14	28	54	+84	29·2
—	16	7	Algol ...	min.							
2	12	0	λ Tauri ...	—							
—			S Hydrae ...	max.	7·5	...	8	46	0	+3	36·8
4	13	6	Algol ...	min.							
5	14	3	S Cancri ...	—	10	...	8	35	39	+19	33·2
6	10	8	λ Tauri ...	—							
—			R Bootis ...	max.	6·8	...	14	30	48	+27	22·1
7	10	4	Algol ...	min.							
10	7	2	Algol ...	—							
—	9	7	λ Tauri ...	—							
14	8	6	λ Tauri ...	—							
—			S Delphini ...	—	11	...	20	36	24	+16	34·2
15			S Vulpeculæ ...	max.	8·7	...	19	42	27	+26	55·7
18	7	4	λ Tauri ...	min.							
21	18	5	Algol	—							
24	13	5	S Cancri	—							
—	15	3	Algol	—							
25			T Aquarii ...	max.	7	...	20	42	17	—5	40·9
27	12	1	Algol ...	min.							
28			R. Orionis ...	max.	9	...	4	51	8	+7	54·4
29			R. Crateris ...	—	?	...	10	53	26	—17	32·8
30	8	9	Algol ...	min.							

* Hour and fraction of hour.

SUN.

Greenwich, Noon. 1871.	Heliographical longitude of the apparent centre		Heliographical latitude of the sun's disc.	Angle of position of the sun's axis.
	°		°	°
Nov. 1	174·94	—61 δ ξ	4·18 N	24·65
2	188·14		4·08	·47
3	201·34		3·97	·29
4	214·54		3·87	·10
5	227·74	—57 δ ξ	3·76	23·90
6	240·94		3·65	·70
7	254·14		3·54	·48
8	267·34		3·43	·26
9	280·54		3·31	·03
10	293·74		3·20	22·79
11	306·94		3·09	·55
12	320·14	—50 δ ξ	2·97	·30
13	333·34		2·85	·04
14	346·53		2·74	21·77
15	359·73		2·62	·49
16	12·93		2·50	·21
17	26·13		2·38	20·92
18	39·32		2·26	·62
19	52·52	—43 δ ξ	2·14	·31
20	65·72		2·02	·00
21	78·91		1·89	19·68
22	92·11		1·77	·35
23	105·30		1·64	·02
24	118·50		1·52	18·68
25	131·70		1·40	·33
26	144·89	—36 δ ξ	1·27	17·97
27	158·09		1·14	·61
28	171·28		1·02	·24
29	184·48		0·89	16·87
30	197·67		0·76	·49
Dec. 1	210·86	—31 δ ξ	0·64 N	·10

MOON'S TERMINATOR.

Greenwich, Midnight		60°N.	0° SUNSET.	60° S.
		°	°	°
1871. Nov.	1	+39·7	+37·8	+35·9
	2	27·5	25·7	23·8
	3	15·3	13·5	+11·7
	4	+3·1	+1·3	—0·4
	5	—9·1	—10·8	12·6
	6	21·3	23·0	24·7
	7	33·6	35·2	36·8
	8	45·8	47·4	49·0

	9	58·0	59·6	61·2
	10	70·3	71·8	73·3
	11	—82·5	—84·0	—85·5
	—			
			SUNRISE.	
	15	+45·9	+47·2	+48·5
	16	33·7	35·0	36·3
	17	21·6	22·8	24·1
	18	+9·5	+10·7	+11·9
	—			
	19	—2·7	—1·5	— 0·3
	20	14·8	13·7	12·5
	21	26·9	25·8	24·7
	22	39·0	38·0	36·9
	23	51·1	50·1	49·1
	24	63·2	62·2	61·3
	25	—75·3	—74·4	—73·5
			SUNSET.	
	27	+82·1	+81·4	+80·6
	28	70·0	69·2	68·5
	29	57·8	57·1	56·4
	30	45·6	44·9	44·3
Dec.	1	+33·4	+32·8	+32·2

THE PLANETS FOR NOVEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	2nd	14 29 18	—14 27	4″·6	23 46·3
	15th	15 21 20	21 19½	4″·8	0 14·8
Venus ...	1st	11 55 8	—0 56½	39″·0	21 10·3
	15th	12 33 3	2 46½	31″·8	21 53·1
Jupiter ...	1st	8 7 7	+20 29	37″·3	17 22·9
	15th	8 8 38	20 27	39″·1	16 29·4
Neptune ...	1st	1 24 45	+7 1		10 41·7
	13th	1 23 37	6 55		9 53·3

Mercury is an evening star, but for a very short time—the interval between its setting and the sun's varying from one minute at the beginning to thirty minutes at the end of the month.

Venus is at her greatest brilliancy on the 1st of the month. She rises about three hours and a half before the sun, the interval increasing each day to the end of the month, when she rises four hours and a half before sunrise.

Jupiter is getting well situated for observation. He rises about four hours and three quarters after sunset, at the beginning of the month the interval decreasing.

Erratum in No 106, p. 247, line 15, for *doom* read *down*,

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. B. Ceti. —
Wed	1	 23 10 7 30 8 24	Venus at greatest brilliancy Sidereal Time at Mean Noon, 14h. 41m. 19·76s. Superior conjunction of Mercury Occultation of ι Geminorum (5) Reappearance of ditto	4th Ec. D.	17 38 12	9 54·2
Thur	2	10 54 16 11 17 19	Near approach of ω Geminorum (6) Occultation of 48 Geminorum (6) Reappearance of ditto	4th Oc. R. 3rd Tr. E.	9 36 11 26	9 50·3
Fri	3	21 44 17 37 18 19	Conjunction of Moon and Jupiter, 2° 56′ S. Occultation of μ^1 Cancri (6) Reappearance of ditto			9 46·3
Sat	4	1 0 9 54	Conjunction of Moon and Uranus, 2° 44′ S. Near approach of γ Cancri ($4\frac{1}{2}$)	1st Sh. I. 1st Tr. I.	16 54 18 9	9 42·4
Sun	5	0 55	☾ Moon's Last Quarter Sun's Meridian Passage, 16m. 17·64s. before Mean Noon	1st Ec. D. 2nd Sh. I. 3rd Ec. D. 2nd Tr. I. 1st Oc. R. 2nd Sh. E.	14 9 26 14 53 16 58 29 17 26 17 41 17 46	9 38·5
Mon	6	12 51 13 36 14 29	Occultation reappearance of B.A.C. 3579 (6) Occultation of ι Leonis (6) Reappearance of ditto	1st Sh. I. 1st Tr I. 1st Sh. E. 1st Tr. E.	11 22 12 37 13 41 14 56	9 34·5
Tues	7			1st Oc. R. 2nd Oc. R.	12 9 15 4	9 30·6
Wed	8	19 23	Conjunction of Moon and Venus, 5° 50′ S.	1st Tr. E.	9 24	9 26·7
Thur	9			3rd Sh. E. 3rd Tr. I. 3rd Tr. E.	10 12 11 46 15 14	9 22·7
Fri	10			4th Tr.. I. 4th Tr. E.	13 16 17 22	9 18·8
Sat	11			1st Sh. I.	18 47	9 14·9
Sun	12	5 8 14 35	● New Moon Conjunction of Moon and Mercury, 3° 18′ S.	1st Ec. D. 2nd Sh I.	16 2 34 17 26	9 10·9
Mon	13			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	13 16 14 27 15 35 16 47	9 7·0
Tues	14	5 16	Occultation of λ Sagitarii (3)	1st Ec. D. 2nd Ec. D. 1st Oc. R. 2nd Oc. R.	10 30 51 12 14 32 13 59 17 34	9 3·1
Wed	15	7 35 8 43	Conjunction of Moon and Mars, 0° 0′ Conjunction of Moon and Saturn, 1° 49′ N. Illuminated portion of disc of Venus=0·372 „ Mars=0·937	1st Tr. I. 1st Sh. E. 1st Tr. E.	8 55 10 3 11 15	8 59·1
Thur	16	1 33 7 2	Conjunction of Saturn and Mars, 1° 47′ S. Occultation of h^2 Sagittarii ($4\frac{1}{2}$)	3rd Sh. I. 2nd Tr. E. 3rd Sh. E. 3rd Tr. I.	10 49 12 1 14 11 15 29	8 55·2

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon. —
Fri	17		Sidereal Time at Mean Noon, 15h. 44m. 24·65s.			4 40·8
Sat	18	20 46 7 3 7 49	☾ Moon's First Quarter Occultation of ε Capricorni (4½) Reappearance of ditto Saturn's Ring: Major Axis=34·85″ Minor Axis=10·16″	4th Ec. D. 4th Ec. R.	11 37 41 15 12 27	5 37·9
Sun	19		Sun's Meridian Passage 14m. 29·99s. before Mean Noon.	1st Ec. D.	17 55 44	6 30·4
Mon	20			1st Sh. I. 1st Tr. I. 1st Sh. E.	15 10 16 17 17 29	7 19·1
Tues	21	3 19	Near approach of 33 Piscium (5)	1st Ec. D. 2nd Ec. D. 1st Oc. R.	12 24 2 14 50 56 15 48	8 4·8
Wed	22			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	9 38 10 44 11 57 13 4	8 48·7
Thur	23			2nd Sh. I. 1st Oc. R. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E. 3rd Sh. I. 3rd Sh. E.	9 16 10 15 11 30 12 10 14 25 14 48 18 10	9 31·7
Fri	24	13 34 22 31	Conjunction of Venus and θ Virginis (1·3m.) E. Conjunction of Venus and θ Virginis 0° 6′ N.			10 15·0
Sat	25			2nd Oc. R.	9 14	10 59·2
Sun	26	13 53	○ Full Moon			11 44·8
Mon	27	10 10 11 23 13 55	Occultation of ι Tauri (5) Reappearance of ditto Near approach of 105 Tauri (6)	3rd Oc. D. 4th Tr. E. 3rd Oc. R. 1st Sh. I. 1st Tr. I.	8 58 9 42 12 28 17 4 18 6	12 32·1
Tues	28			1st Ec. D. 2nd Ec. D. 1st Oc. R.	14 17 17 17 27 20 17 35	13 20·8
Wed	29	19 55	Near approach of ω Geminorum (6)	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	11 32 12 32 13 51 14 52	B. Ceti. — 8 3·1
Thur	30			1st Ec. D. 2nd Sh. I. 1st Oc. R. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E. 3rd Sh. I.	8 45 36 11 50 12 2 13 51 14 43 16 46 18 46	7 59·1
DEC. Fri	1	4 30 7 25 18 8 19 20	Conjunction of Moon and Jupiter, 2° 57′ S. Conjunction of Moon and Uranus. 2° 49′ S. Occultation of γ Cancri (4½) Reappearance of ditto	1st Sh. E. 1st Tr. E.	8 20 9 19	7 55·2

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN NOVEMBER, 1871.

By W. R. Birt, F.R.A.S.

Day.		Supplement ☾ — ☉ Midnight.		Objects to be observed.
		° ′		
14	...	148 12·1	...	Mare Smythii (*a*), Kästner Hecatæus.
15	...	134 24·9	...	Eimmart, Plutarchus, Seneca.
16	...	120 51·5	...	Strabo, Thales (*b*), Euctemon.
17	...	107 35·6	...	Lacus Somniorum, Mason Baily.
18	...	94 39·1	...	Maurolycus, Barocius Bacon.
19	...	82 2·2	...	Aratus, Mt. Hadley, Conon.
20	...	69 43.9	...	Birmingham (*c*), Goldschmidt (*d*), Challis, Main (*e*).
21	...	57 42·6	...	Fontenelle Region about the North Pole.
22	...	45 56·6	...	Pallas, Bode, Uckert (*f*), Triesnecker.
23	...	34 24·2	...	Bouguer, Louville, Censorinus (*g*).
24	...	23 3·6	...	Tobias Mayer (*h*), Oceanus Procellarum.
25	...	11 53·3	...	Harding, Repsold, Œnopedes.
26	...	0 51·7	...	Leibnitz Mountains Bouvard.

For additional objects consult the lists for July and September.

(*a*) Libration is bringing this fine formation on the west limb (marked by the late Dr. Lee, to commemorate the astronomical labours of the author of the Bedford catalogue) into a favourable position for observation. It may be well studied during the progress of the lunation.

(*b*) Thales is a fine ray centre, the epoch of the first appearance of the streaks should be determined.

(*c*) This formation the second westward from Fontenelle, which comes into sunlight later, is not on Webb's map, and so far as I am aware, is unnoticed by Bandell. Mr. Birmingham first called attention to it, and as he was the discoverer of T Coronœ, the appellation "Birmingham" will be the most suitable for it as commemorating the two discoveries. The formation is described under the title of Telescopic Work for Moonlight Evenings in the *Student*, July 1870, p. 323, and also in the *English Mechanic*, July 22, 1870, p. 418.

(*d*) A fine walled plain between Barrow and Anaxagoras, named by the late Dr. Lee to commemorate the discoveries of Goldschmidt.

(*e*) The two craters between Scoresby and Gioja have been named Challis and Main.

(*f*) Mr. Neison is now engaged in observing the region around Pallas, sketches of this interesting locality under every illumination are very desirable.

(*g*) Censorinus is vividly bright and seen under every illumination. Its degree of of brilliancy should be compared with those of Procus Dionysius, the surface around Kepler, and Aristarchus. The centre mountain of Aristarchus is reckoned as 10°, the surface around Kepler as 5°

(*h*) Tobias Mayer is a minor streak, centre in the neighbourhood of the great outburst from Copernicus.

Gassendi. Selenographical students will find in the *English Mechanic* for October 13th, 1871, p. 99, a plan of Gassendi with catalogue of referenced objects, which they will do well to identify, with the exception of 111 B, Sigma 31, and the clefts 28, 29, and 30, they may be seen with apertures under 6 inches.

THE AZTECS' CALENDAR STONE.

The American Minister to Mexico has forwarded Governor Baker, of Indiana, a valuable and curious contribution to the State library, in the shape of a model of the calendar stone of the Aztecs, the discovery of which shows how accurately those ancient people of Mexico measured the lapse of time. Mr. Nelson says the calendar stone was discovered on Dec. 17, 1790, not far from the centre of the principal square, and directly in front of the entrance to the palace. It was lying flat, with its sculptured side downward, and the upper part only 18 inches from the level of the ground. By order of the viceroy, and at the request of the authorities of the cathedral, it was delivered to them, on condition of being placed in some position easily accessible to the public.

The material of the calendar stone is an exceedingly hard basalt, found only at a great distance from the city of Mexico. It is 11 feet 8 inches in diameter, and about 2 feet 6 inches in thickness. The Aztec civil year consisted of eighteen months of twenty-five days each, to which were added five complementary days that were not considered as belonging to any month, and were regarded as unlucky by the Aztecs. At the expiration of each cycle of fifty-two years, twelve days and a half were interpolated to compensate for the six hours annually lost. The conclusion of each cycle was a memorable event in Aztec annals. The perpetual fires in the temple and all the fires in the private dwellings were extinguished; they destroyed much property, and literally "clothed themselves in sackcloth and ashes." At midnight of the first day of the new cycle imposing religious ceremonies were celebrated by the people *en masse*, including the sacrifice of human victims, and the lighting of a new fire by friction from a wooden shield placed on the breast of a victim. This fire was then communicated to torches borne by thousands of runners, who conveyed it to the remotest settlements of the Aztec empire.

Mr. Gallatin draws from the detailed examination of the hieroglyphics the following conclusion:—"We find, therefore, delineated on this stone all the dates of the principal positions of the sun, and it thus appears that the Aztecs had ascertained with considerable precision the respective days of the two passages of the sun by the zenith of Mexico, of the two equinoxes, and of the summer and winter solstices. They had, therefore, six different means of ascertaining and verifying the length of the solar year, by counting the number of days elapsed till the sun returned to each of these six points; the two solstices, the two equinoxes, and the two passages by the zenith."—*Antiquary.*

ENCKE'S COMET, NOVEMBER, 1871.

1871.		R.A. h. m s.		Decl. ° ′
Nov. 1	...	22 50 30	...	+38 4
3	...	22 30 44	...	37 10
5	...	22 10 32	...	35 58
7	...	21 50 10	...	34 29
9	...	21 29 56	...	32 43
11	...	21 10 5	...	30 41
13	...	20 50 48	...	28 26
15	...	20 32 15	...	25 59
17	...	20 14 31	...	23 24
19	...	19 57 37	...	20 43

1871.		R.A h. m. s.		Decl. ° ′
Nov. 21	...	19 41 32	...	17 59
23	...	19 26 14	...	15 13
25	...	19 11 39	...	12 28
27	...	18 57 46	...	9 45
29	...	18 44 29	...	7 4

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.
Benson, Rev. Dr.
Buffham, T. H.
Dix, F.
Hemming, Rev. B. F.
Jackson Gwilt, Mrs.
Lancaster, J. L.
Lancaster, W. L.
Rump, H. R.
Simkiss, T. M.
Wright, W. H.

To Feb. 1872.
Blacklock, A. W.

To March 1872.
Ingram, Rev. H.

To Dec. 1872.
Birt, W. R.

TO CORRESPONDENTS.

It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

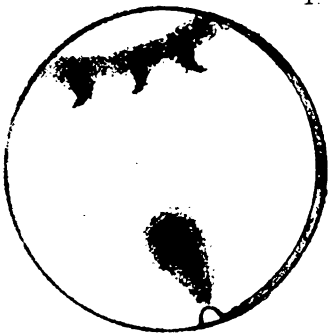
Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*; **not later than the 15th of the Month.**

1. 2. 3 4 March.
5 6. April
1871.

1



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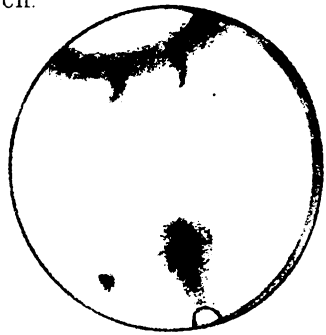

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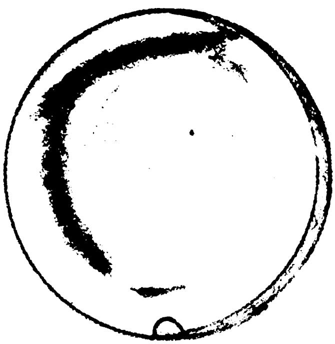

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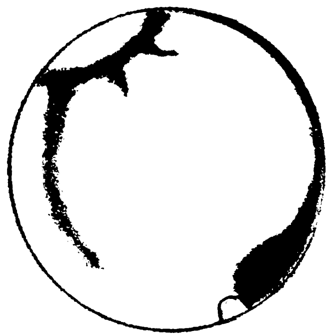

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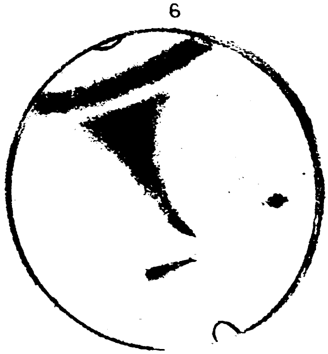
6



Mr Edward Crossley's Observatory, Park Road, Halifax.

The Astronomical Register.

No. 108. DECEMBER. 1871.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

First Meeting, November 10th, 1871.

W. Lassell, Esq., F.R.S., *President,* in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. One hundred and fifty-nine presents were announced, and the thanks of the Society were voted to the donors. Attention was particularly directed to a chart of the eclipse of 1724, the last total eclipse visible in England. This chart was drawn by Dr. Halley, and showed that London was just out of the totality.

The Astronomer Royal said he was not acquainted with this chart, but had read the description of the eclipse by Dr. Stukely, which was very interesting. Mr. Peyton, who presented the chart, said that it had been found in a book 144 years old, which had belonged to a Commissioner of the Navy.

Joseph W. Freeman, Esq.,
Robert H. W. Bosanquet, Esq., and
Harry Taylor, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Notes on the Construction of the Heavens, explanatory of a Chart of 324,198 *Stars*: by Mr. Proctor.

Mr. Brothers exhibited a photographic negative of this chart, and stated that Mr. Proctor considered Argelander's Maps of the Northern Hemisphere superior to any former work of the same kind. In the preparation of the original chart, which was two feet in diameter, each division of 50 was covered up as soon as completed, in order to avoid any bias in favour of any plan. The work was continued without interruption, except for food and rest, in order that the style of mapping might not alter. Taking one minute for 10 stars, the chart should have occupied 540 hours, but it only took 400, and no change of style could be detected where the work ended, and where it began.

The Astronomer Royal said the chart was a work of great interest, but it struck him that the principal stars were rather too small to be distinguished. He had looked in vain for Vega, Arcturus, Capella, and the well-known configuration of Orion, Cassiopeia, etc.; and he thought if this could be altered, even now, it would be an improvement; at present it looked all star dust.

The President: I have felt this, too; I cannot find the Great Bear.

Mr. Brothers explained that if the scale of magnitudes had been larger, the stars would have encroached on each other. Already they nearly did so. It must be remembered that only stars down to the equator were included, so that the top star of Orion's belt was the limit of the stars in that constellation. If held properly, all the principal groups could easily be found.

Mr. Dunkin had readily picked out all the principal stars.

The President: Still it is not like the heavens where the stars do not seem so crowded.

Capt. Noble: If stars of the second and third magnitude had only been included, it would have been easy to make the chart more distinct; but, if the number included were considered, it was clear the scale did not allow of greater differentiation.

Mr. Brothers: The number shows that many more stars than can be seen with the naked eye are included; only a few thousand stars can ever be seen at once by the eye.

Col. Strange: This answers the objection; no eye ever saw what this chart displays.

Dr. Huggins: If the eye were a 2-inch telescope, it would see the stars here mapped, but not otherwise.

Observations of Encke's Comet: by the Astronomer Royal.

R. A. and N. P. D. of the same: by the same.

The comet, as described by Mr. Carpenter, was large and faint. The diameter of the brightest part was about equal to an interval of the wires used in eye and ear observations—that is, about 240″. The comet was somewhat fan-shaped, and had no nucleus. The places were taken of the brightest part, and the power used was 50.

	G. M. T.	R. A.	N. P. D.
	h m s	h m s	° ′ ″
Nov. 8 ...	6 28 45	21 38 42·5	
		21 38 47·7	56 54 27
9 ...	6 15 7	21 29 0·5	57 48 7

The Astronomer Royal added that the transit observations were made with difficulty, from the size of the comet being six or eight minutes, while the instrument was made for stars. He wished particularly to call attention to its peculiar form, which was a short parabola, and the direction of its axis with regard to the sun. He had requested Mr. Carpenter to draw it on the globe on the table, and it would be seen that the fan-shaped part was directed nearly towards the sun; its edge was a hard curved line on one side, but very ill-defined on the other towards the sun.

Dr. De la Rue: The tail, then, is turned towards the sun?

The Astronomer Royal: Yes, if you call it a tail. In R. A., too, the tail goes first. It has been examined in the great equatorial as well as the transit. The paper states that last evening it continued still the same. It is easily seen in the finder of the equatorial.

Dr. Huggins: I have been observing the comet for the last few nights, and quite confirm the general accuracy of Mr. Carpenter's drawing, but I should make it rather brighter in the central part. The nebulosity is cut off nearly in a straight line, as he describes it, and it extends a considerable distance. I see a minute stellar nucleus rather below the centre of the apex. On two evenings I have examined its spectrum. This is very faint indeed. Nearly the whole of the light is concentrated in one band in the less refrangible end, and nearly identical with *b*. This band could be traced for a short distance. I had also a suspicion of two other faint bands, one of which, coincided with the central band of the comet of 1868, which lines I found to be due to carbon vapour. I have since compared the comet's spectrum with the actual carbon bands, placing the spectrum of the comet between the carbon lines above and below, when the coincidence seemed complete, so far as it could possibly be observed, and the comet seems to have the same constitution as Winnecke's. The stellar

nucleus is quite distinct, but very minute. The aperture of the telescope is 15 inches.

The President, referring to the drawings, thought that the fan was not so widely separated in his 2 ft. reflector as Mr. Carpenter showed. There was no nucleus, properly speaking, but only condensation in one place.

Dr. Huggins thought the comet, as seen by him, looked like Mr. Carpenter's drawing surrounded by a larger envelope.

Some further discussion took place as to the comparison between the drawings, which were ultimately proved to be quite similar.

Note of Warning to Stereoscopic Theorists: by Mr. Drach.

The author evidently meant *spectroscopic*, and not *stereoscopic*. He objects to founding any conclusions as to the existence of organic life in celestial bodies, on the gases discovered by the spectroscope in their atmospheres, and hopes that astronomy will not be directed to subjects "beyond our ken," and suggests that the gases present may have organisations adapted to them.

Occultations of Stars by the Moon: by Capt. Noble.

1871, Sept. 24. ϕ Capricorni disappeared instantaneously at the dark limb of the moon at 22h. 50m. 33·5s., L. S. T.=10h. 37m. 18·14s., L. M. T.

Power 154. Atmospheric undulation tremendous.

1871, Oct. 23. τ^1 Aquarii disappeared instantaneously at the dark limb of the moon at 22h. 49m. 44s., L. S. T.=8h. 42m. 27·5s., L. M. T.; and reappeared at the bright limb at 23h. 23m. 56s., L. S. T.—9h. 16m. 34s., L. M. T.

The motion was so oblique as to render the observations uncertain.

τ 2 Aquarii, a more conspicuous star, disappeared instantaneously at the dark limb of the moon at 23h. 57m. 27·8s., L. S. T. =9h. 50m. 0·2s, L. M. T.; and reappeared pretty sharply at the bright limb at 1h. 7m. 29·8s. L. S. T.=10h. 59m. 50·7s., L. M. T.. The limb was mountainous, boiling, and bubbling.

Power 255.

Note on the Inferior Conjunction of Venus: by Capt. Noble.

On Sept 26, Venus was observed 1h. 37m. after she had passed her inferior conjunction. The atmosphere was bad, and the dark body of the planet was not visible in a constricted field, as it had been on former occasions.

Capt. Noble added that the last remark might be explained, by supposing the light background to be variable in lustre, as he had always before seen the dark outline.

The President enquired how near Venus was to the sun. He had seen it within 2½ diameters.

Capt. Noble could not answer exactly, but he had seen the planet nearer before, in fact, with the sun shining on the object-glass. His plan was to pierce a hole in a card diaphragm, with a red hot needle, and the card being fitted to the stop of the eye-piece, showed the dark body of Venus like the moon a few days old.

The President thought that Venus was at a considerable distance from the sun at this conjunction.

Mr. Lynn saw the planet all round at this very conjunction.

The Astronomer Royal, recurring to the subject of Encke's comet, remarked that he was probably the only person in the room who saw this comet in 1828. It was then nearly in opposition, and the form was totally different to its present shape, being then nearly circular. Struve, at Dorpat, with a larger telescope, also saw it of the same shape. Now it looked like one within another.

Mr. Dunkin: It was then 15 minutes in diameter.

Mr. Buckingham: And is now 7 minutes.

The President enquired whether the acceleration was still obvious.

The Astronomer Royal said it was not known yet.

Remarks on an Envelope of Red Matter, surrounding the Solar Photosphere: by Professor Grant.

This paper was devoted to showing that the author was the first to deduce, from the numerous observations of total solar eclipses before and since 1842; that in addition to the red prominences, there was a continuous layer of bright red matter, which was now called the *chromosphere*, and he explains by means of a diagram how the position of the arc of this covering generally seen, or the *sierra*, as it was frequently called, would vary according to the observer's place compared with one in which the eclipse was central. He also mentioned that on November 30, 1872, there would be an eclipse which it was calculated would be total at the beginning, annular in the middle, and total again towards the end; and he thought this would be a favourable opportunity for observing the chromosphere, which Secchi said was 13″ in thickness.

The Astronomer Royal explained that the eclipse would not vary in the manner described at any one place.

Mr. Ranyard observed that the observations of these streaks of light had been collected by Schmidt of Athens, and it appeared that this stratum was lower than the chromosphere, and might, perhaps, account for the reversed bright Fraunhofer lines seen by Professor Young and Mr. Pye.

The Astronomer Royal would call attention to the plates illus-

trating the account of the eclipse of 1851, in the Society's Memoirs, which showed a bright red sierra for 40 or 50 degrees; and he particularly remarked that the colour was not the same as that of the prominences, being a pale scarlet, while the others were lake, and he had no doubt this was the origin of the beautiful blush in the horizon on one side.

Mr. Dunkin said that his station at Christiana was on the northern limit; it was a good station for the purpose, but not being clear, he saw no sierra; a rose-coloured blush was, however, noticed by one of his assistants.

Mr. Penrose called attention to the great contrast to these observations found in Spain at the last eclipse. There was an utter absence of anything of the kind. The clouds continued till 40 seconds before the totality, and when he looked at the distant mountains, expecting some colour, he found a remarkable want of it; they were greenish brown, with no tendency to rose.

Les Variations de la Pesanteur dans les Provinces Occidentales de l'Empire Russe: by M. Sawitsch.

This was a paper on the observations of the remarkable change in the force of gravity in some parts of Russia, which would require study when printed.

Discovery of New Nebulæ: by M. Stephan.

This was a list of the places of a considerable number of new nebulæ found by the author with the large silvered glass reflector of the Marseilles Observatory.

The Rev. F. Howlett wished to mention that, while observing the sun with a spectroscope, on a very fine and tranquil afternoon in September, and while noticing the bright bands of hydrogen on the dull spectrum, he had been surprised by a beautifully brilliant prismatic stripe running from end to end of the spectrum. He then thought it might arise from thistle down, distant insects, or other terrestial bodies; but, subsequently, reading Mr. Proctor's last paper on the Corona, in the *Monthly Notices*, in which the author, quoting Zollner's account of some such flashes, thinks they may be connected with erupted matter, he was desirous of knowing the opinion of the fellows on the subject, and of asking whether the proportion the velocity of light bore to the diameter of the sun might have anything to do with it.

Mr. Gibbs did not know what the appearances were, but he had seen them frequently passing from the red to the yellow.

Mr. Browning exhibited *a Model of a Mounting for a Large Equatorial Reflector*, in which the Polar axis could be adjusted for different latitudes, almost from the Equator to the Pole. He said that, having been requested by the Astronomer Royal to alter the Equatorial Reflector,used by Major Tennant for photographing the eclipse of 1868, for the coming eclipse, and also for photo-

graphing the transit of Venus, he had done so, and been aided by Dr. De la Rue in his plan. He, however, thought he could do better in future, and made the model shown, to scale. In this, which he described in detail, the Polar axis could be raised from its horizontal position at the Equator to 60° without interfering with the connection to the driving clock. This he always made very large, to prevent it being run away with by the telescope. The model was made with a view to future operations; but, before it was completed, he had received an order from Mr. Collier, of Sydney, for a 10¼-inch reflector, which was first to be used in Australia, and then probably brought to England, so that his labour had at once become available. He was sure Mr. Collier would be happy to allow any competent observer the use of his instrument when he received it.

The Astronomer Royal said that formerly equatorials were made for observatories, but now they were adapted for flying expeditions. It was curious that this was not thought of when Major Tennant's was constructed. He also mentioned that Venus was now in a most favourable position for observation, and that, having laid down Bianchini's markings on a globe, neither Mr. Carpenter nor himself could see any of them.

The President: Neither have I.

Capt. Noble said that the *Observing Astronomical Society* had reported some marks.

Dr. Huggins said he had never been able to see anything like the markings of the early observers. Of course, there were some at the terminator, and, sometimes, he had fancied he saw a difference in brightness near the convexity, but the appearances were delusive.

Dr. De la Rue said that he had many times seen markings on Venus, and drawn them. They reminded him of Mars, but were much less distinct. When the atmosphere was good, he had generally seen them.

Col. Strange asked whether he had ever shown them to other persons.

Dr. De la Rue replied that it rarely happened he had anybody with him when observing, but he would bring the drawings.

Dr. Huggins said that on this morning he had seen some irregularities, as if the surface were pitted with little craterlets, like the moon.

Mr. Browning had seen these, too, and thought them real, but had seen no large markings.

Mr. Buckingham noticed, in 1865, at inferior conjunction, that three pieces seemed apparently wanting to complete the configuration, but he did not see any markings.

Dr. De la Rue made a rough sketch of the marks. They were best seen when Venus was gibbous.

Col. Strange enquired whether any medium had been used to subdue the glare?

Dr. De la Rue said, No. He observed with a reflector, and generally used a concave eye-glass.

Capt. Noble remarked that every one had seen the cusp cut off, and, if this were due to a mountain, there might be markings elsewhere; but, until Dr. De la Rue spoke, he had heard no trustworthy account of such being observed.

Dr. De la Rue said everyone had the right to doubt what he did not see himself. He remembered that, on sending his picture of Saturn to Sir J. Herschel, the latter wrote him a letter saying that if he could see the planet like that, he should die contented, but many had since seen, and testified to the accuracy of that drawing. Venus, like the moon, had darker parts, which interfered with the line of the terminator, but were not necessarily mountains.

On the Zodiacal Light: by Capt. Tupman.

This paper introduced a most valuable and careful series of drawings of the phenomenon, made by the author in the Mediterranean, which would be engraved for the publications of the Society, and deserved attentive study.

Mr. Ranyard called attention to the axis of the zodiacal light in these drawings, which did not coincide with the ecliptic, but often intersected it at enormous distances, even sometimes as much as 45° from the sun.

Errors in Logarithmic Tables: by Mr. Wackerbarth.

Observations of Saturn, Mars, &c.: by Mr. Spear.

On the Precession of the Equinoxes: by Mr. D'Oyley.

Observations of Solar Spots: by M. Beer.

On the supposed change of the Nebula round μ Argus: by Mr. Lassell.

This paper has already been printed in the *Monthly Notices.*

The meeting then adjourned.

DRAWINGS OF MARS.

In the October number of the *Register*, a few remarks on the appearances seen on the disc of Mars were inserted, and reference was made to some lithographed sketches. Several observers having applied for copies of these rough drawings, a number has been printed for insertion in the *Register*. It is hoped that, rough as they are, they may be interesting to many who directed their telescopes to the planet in the spring of this year.

JOSEPH GLEDHILL, F.G.S., &c.

Mr. E. Crossley's Observatory,
Park Road, Halifax.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

JUPITER.

As early as the 9th of October, a very large dark spot was seen in the bright zone bounded by bands 2 and 3 (see *Register*, No. 88, 1870, for diagram), and connecting these bands together. On turning to the planet soon after midnight, Nov. 8th, other new objects caught the eye in this region. Band No. 3, which has not been a very well-defined streak for years, perhaps, had at this time three large dark spots upon it. The two western were the larger. In size and general appearance they closely resembled the dark forms which separate the bright ovals under No. 4. No. 1 was not visible. No. 5 was a very fine broad streak, very nearly as broad as No. 2 (the finest of all), but not so dark. This band was soft and flocculent in character. To the south of No. 5 no other distinct band could be detected. The cloudiness about the southern Pole was of a leaden hue, and much darker than that about the opposite polar region. The festoons under No. 4 were easily seen.

A little later the eastern third of band No. 3 did not shade imperceptibly into the central dark zone, but had a narrow bright space above it. As the planet rotated, this feature was soon seen to be a new band between Nos. 2 and 3. No. 2 now had a dark spot on its northern edge. No. 1 was now seen at the eastern edge of the disc.

At 3 a.m., Nov. 9th, a narrow and somewhat faint band began to appear to the south of No. 5. The new streak, which was now invisible on the west, appeared again in the east.

As far as observed, the striking changes on the disc, since the last apparition, may be thus described :—

1. No. 3 has now large spots upon it.
2. A new belt has appeared between Nos. 2 and 3.
3. A very large spot lies in the bright zone between Nos. 2 and 3, connecting them together.

During the winter of 1869-70 the southern regions seemed to be those of greatest change. At present the northern zones exhibit the most marked and extensive changes.*

JOSEPH GLEDHILL, F.G.S., &c.
Mr. Crossley's Observatory,
Park Road, Halifax.

Nov. 10, 1871.

* Several minor details are shown of the sketches made at the time. As our micrometer was at York under repair, no measures were taken.

JUPITER.

Sir,—The phenomenon described by Mr. Holden was, unquestionably, a most magnificent and stupendous one. Changes so vast, and so sudden, on the disc of Jupiter have rarely, if ever, occurred since telescopes have been directed to this noble planet. Unfortunately for us here, a gale was blowing on the 20th of February last, and so we are unable to confirm the statements of Mr. Holden. We ought to add, however, that the planet

was never visible here without being carefully watched the whole night long with our 9¼-inch refractor; and that no such appearances as those described by Mr. Holden were seen either before or after the date he gives.* Considerable changes have taken place since February last; and these, though not so vast as those mentioned above, will yet be readily detected on a careful scrutiny of the planet during one rotation.

I am, Sir, yours very truly,
JOSEPH GLEDHILL, F.G.S. &c.

Mr. E. Crossley's Observatory,
Park Road, Halifax :
November 14th, 1871.

* We observed the planet on February 21st and 25th, and brought our work to a close on the 8th of April.

OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS OF VENUS

Sir,—In your number for March last, page 63, I invited, on behalf of the above society, the assistance and co-operation of observers generally, in the carrying out of a systematic series of observations of the planet Venus, during one complete synodical revolution. These observations were proposed to be made in order to endeavour to obtain, if it were possible, a better knowledge of the nature and character of the dusky markings which have been occasionally seen to diversify the disc of the planet. It was also proposed to collect all former sketches and records of the appearance of the markings, so that a mass of data might be collected from which it would be possible to say, with some degree of certainty, their forms and degree of permanency. In response to our invitation, many observers, some of whom are in the possession of instruments of large aperture, promised their active assistance, and the result is that the planet has, on very many occasions, been subjected to a careful examination, and the forms and general appearance of the dusky streaks and markings delineated. In all, I have received fifty sketches of them; and now that Venus is again formally situated as a morning star, it is probable that this number will soon be considerably increased. That the markings are very faint objects, and very difficult objects, is evident from the sketches, which show dusky, cloudlike appearances of irregular forms. On several occasions, two observers have succeeded in obtaining observations on similar dates, and their representations of the spots are somewhat analogous; but, in respect to the details, a dissimilarity is found to exist. Considering, however, the difficulty of clearly tracing the exact outline of these faint appearances, it is not surprising that there should be some little discordance apparent in some instances. It is satisfactory though to know that the general form of the markings, as observed on the same evening by two observers, accord very fairly, thus proving that every reliance may be placed on the results obtained. It is not, however, only to the workings on the planet's surface that the attention of the observers has been directed, but also to the irregular appearance of the outline of the terminator. This has been often detected; and, on some occasions, the positions and extent of the inequalities have been noted. In examining this planet, observers should be careful to scrutinise the terminator, so that if any irregularities are visible they may come under observation.

It is intended to continue the observations (which commenced on March 20 of the present year) until October, 1872, and effectually accomplish the collection of all previous drawings and records of this planet; the

Society will necessarily require the assistance of amateur observers and others, who may have in their possession any sketches or results of observations of the markings. It will also be very necessary to consult the works of the earlier observers, so that all the data possible may be collected and placed before a thoroughly competent astronomer, who will carefully subject it to a careful investigation, and decide as to the character and forms of the dark streaks and markings, which have been for so many years supposed to be utterly invisible to any but the most powerful telescopes. Now, however, that they have been undoubtedly and frequently seen with the aid of instruments of very moderate aperture, it is not improbable that they will be more generally looked for; and that, as a consequence, their forms, degree of visibility, and permanency will be better understood.

I shall be glad if those of your readers, who possess any observations or sketches of the planet, will send me all or a portion of the particulars of them, so that they may be compared with the other results. By doing this they will be materially aiding the Society in its endeavour to advance our astronomical knowledge. I shall also be pleased if any gentlemen, who have not previously expressed their willingness to assist us by making observations of the planet, will undertake to occasionally do so, and forward the results to me.

It will be interesting, perhaps, to describe some of the observations that have already been made. I am of this opinion because, of late years, there has been but little said in reference to the markings:—

1871.—April 22, 8h. 15m. Three elongated markings observed running parallel to the planet's equator. From the sketch, it would seem that they are not altogether unlike the belts of Jupiter—8¼ in. O.G.

May 1, 8h. 25m. Two dusky markings on the eastern part of the disc —8¼ in. O.G.

May 7, 7h. 55m. One large cloudlike object observed on the disc. It extended over nearly one-half of the illuminated portion of the planet's surface, running from N. to S., and was most intense a little N. of the centre of the disc—8¼ in. O.G.

May 10, 8h. The planet was clear and well-defined. They reminded Mr. Ormesher, who observed them, of the dusky spots of Mars, as they had much the same appearance. One large spot was in the E. part of the disc, and two other elongated markings or streaks were noticed running from N. and S., and a little from the centre—5¼ in. O.G. power 181.

May 12, 8h. A dark, faint object observed a little E. of the centre of the disc. From this sketch, and indeed from most of the others, it would appear that the edges of the cloudy markings fade away gradually, and not terminate abruptly, with a well-marked outline as in the case of the penumbra of solar spots—8¼ ir. O.G.

May 12, 8h. 15m. A very peculiar, large marking observed. It was somewhat similar in form to an X, and some portions of it were traced nearly up to the terminator. The centre of this irregular marking was a little W. of the middle of the illuminated portion of the disc— 8¼ in. O.G.

May 18, 8h. 15m. Three spots of irregular outline visible. Some parts of these spots were much darker than others, and, consequently, much more conspicuous—8¼ in. O.G.

May 21, 1h. 30m. to 2h. 50m. 47s. In addition to two small streaks which were perceptible, the terminator was very irregular, there being a large projection from it—a little from the centre of the disc. One of the markings was very pale, the other situated slightly S. of the planet's centre, was more distinct—5¼ in. O.G. p. 181.

May 22. Two large irregular markings perceptible—8¼ in O.G.

May 24, 8h. 45m. One cloudy object. Object of irregular form seen near the centre of the illuminated part of the disc—8¼ in. O.G.

May 29, 9h. 30m. The markings very similar in form to those seen on May 10. 8h. The largest which was E. of the two others was rather pale—5¼ in. O.G. p. 181.

May 30, 8h. 30m. A large, elongated, and slightly curved marking seen on the E. limb. Two smaller spots near the terminator. One of these, a little S.W. of the centre of the disc, was traced up to the terminator.

June 2, 8h. One large marking seen on the E. limb. It was somewhat similar in form to the Greek letter ε. 13in. refl. The planet was also observed on this date by another observer, whose sketch shows a large elongated marking on the E. limb. The two sketches do not agree, however, in some of the details—8¼ in. O.G.

June 4, 8h. 15m. Large elongated marking seen in proximity to the E. limb. On various other portions, faint dusky spots were noticed.

June 6, 8h. 40m. Two large cloudy spots seen. They appear to be somewhat similar in their form to those observed on May 22—8¼ in. O.G.

June 11, 8h. 30m. Six dusky spots seen. They were much larger than those seen on June 4, 8h. 15m. One of them could be traced up to the terminator. Another representation of this planet shows it with three spots near the terminator, and a large broken ring, of elliptical form, with a faint marking in the centre, nearer the E limb. This ring presents a somewhat analogous appearance to one of the incomplete craters of the moon. A third observer also sketched the planet on this date, and says, "Definition extremely good. The markings were very clearly seen, and bore a very remarkable resemblance to the craters and inequalities of the moon as seen with a low power, say an opera glass. In this sketch the large marking appears to be constituted of small streaks of curved or spiral outline. The same appears to be the case with regard to some representations, by Mr. T. H. Buffham, of the planet's appearance in 1868, which are figured in the *English Mechanic*, No. 345, p. 172.

June 26, 7h. 45m. to 8h. Nearly the entire illuminated portion of the disc appeared to be clouded by a faint dusky covering. Mr. F. Worthington observed that the southern cusp was notched, and appeared very white—13 in. refl. p. 118.

July 1, 8h. 50m. A large spot which "looked like a dark cloud, and stood out boldly," was observed on this and several successive evenings at about the same time—3 in. O.G. p. 130.

July 17, 6h. 30m. Mr. H. W. Hollis, with his 6 in. O.G. p. 150, saw "the rounding off of the S. cusp very distinctly, and the prolongation of the N. one was more remarkable than he had ever before observed it. A dusky, ill-defined, and uncertain shaped spot was visible. On the 18th at 5h. 15m. he inspected the presence of this spot again somewhat nearer to the terminator; but of this I cannot speak positively."

August 7, 6h. The Rev. T. W. Webb writes: "The surface seems in best moments clouded with feeble grey markings, but they are too faint to be distinctly made out. Terminator faint. I do not see any irregularity in it. August 8, 6h. With p. 200. I thought there was something at N. horn. At first it seemed prolonged by a feeble twilight; afterwards I could not make that out, but I fancied there was a bright knot at the cusp, though it remained doubtful. I had, however, the same impression of a knot there with single lens, p. 270."

The above is a summary of a portion of the results obtained; but,

without the sketches themselves, it is impossible to convey a correct impression as to the forms and appearance of the markings which I have briefly described above. Observers agree in stating that they are very faint cloudlike objects. I believe that it has been stated, the late Rev. W. R. Dawes never saw them, although possessed of very excellent vision, as regarded the observation of faint stars. No doubt a satisfactory reason for this can be given. In *Celestial objects*, p. 50, in treating of the markings, Mr. Webb says, that during observations of this planet at Rome, 1839-41, the most successful of six observers in detecting "these faint clouds were those who have most difficulty in catching very minute companions of large stars." "Debico assigns no reason, but it is obvious enough. A very sensitive eye, which would detect the spots more readily, would be easily overpowered by the light of a billiant star, so as to miss a minute one in its neighbourhood." This opinion is strengthened by the fact that most of the observations of the spots, mentioned in the summary, were made with the same telescope that was formerly in the possession of Mr. Dawes. This instrument is now erected at the Temple Observatory, Rugby; and, in the hands of Mr. George M. Seabroke, is doing some good work. The most successful of the other observers are Messrs. F. Worthington and Mr. Henry Ormesher. I shall have pleasure in sending you further particulars as the observations progress.

I am, Sir, yours truly,

WILLIAM F. DENNING, Hon. Sec.

It is worth noting that neither Sir G. B. Airy nor Dr. Huggins have detected any of these markings, though they have carefully looked for them.—Editor.

PROCTOR'S CHART OF 324,198 *STARS.*

Sir,—Will you permit me to make some remarks on an objection urged by the Astronomer Royal against my chart of 324,198 Stars? Mr. Airy seems to have supposed that this chart was intended to aid the observer in the search for individual stars; and, so viewing the matter, objected, very properly, to the circumstances that even the constellations are but barely recognisable. Nothing, however, could have been farther from my thoughts,—nothing, I may say, farther removed from the possibilities of charting—than the construction of a star-seeker's chart, in a 2-feet circle, to contain 324,198 stars. I have, indeed, had in view, as a secondary purpose of my chart, its use in showing observers where the rich regions of the heavens lie; and, in order that it might subserve this purpose, as well as my primary purpose, without being defaced, I added the photo-lithographed key-maps. I need scarcely point out how these, used with the photographic chart, show where the constellations fall in the latter; nor, again, is it necessary to show that if Mr. Airy's plan could possibly have been adopted, *i. e.*, if the leading stars could have been made sufficiently conspicuous, without obliterating a few hundreds of suns, I should have preferred that plan to the expensive one of adding a key-map.

But my primary purpose, in constructing the chart, was to obtain new evidence respecting the constitution of the sidereal heavens; and such evidence the chart does unquestionably afford. It shows that there is a condensation of stars of the leading orders of magnitude (to H's 11th magnitude) on precisely those regions where ♅ found the lower orders (from 12th to 18th) most densely congregated. This relation, unsuspected by ♅, denied by H, and partially recognised, but misunderstood by Σ, is exhibited in my chart, in a manner there is no mistaking.

The consequences of the relation are of extreme importance, for unless the multiplied coincidences noted are purely accidental (which no one will assert), there must be, in the clustering aggregations, a real mixture of orbs, of all degrees of size, from relatively very large ones, to relatively very small ones. The distinction between this result and the *various views* of H, H, and Σ will only be recognised by the few who care to study the subject of stellar distribution in space; it is, however, an important one.

I would submit that it is a trifle hard, after I have given some 400 hours of time to work out a sufficiently definite purpose, that my work should be found fault with, because it does not subserve a purpose I have never contemplated—a purpose, too, which no single chart can possibly subserve. I am reminded of a singular objection urged by the Astronomer Royal against my New Star Atlas—viz., that the maps do not admit of being fixed to a spindle-shaped block rotating on a polar axis. As the famous Mr. Dick defended his room against the observation that "he could not swing a cat there," by the plea that "he didn't *want* to swing a cat," so my answer naturally was, that I had never proposed to have my Atlas Maps "fixed to a spindle-shaped block," &c. A like answer avails in the case of my chart of 324,198 stars.

RICHARD A. PROCTOR.

Brighton: November 15th, 1871.

THE TOTAL ECLIPSE IN DECEMBER NEXT.

To the Editor of the *Times*.

Sir,—Observers of total eclipses of the sun seem to pay but little attention to the fact that probably there exists a hitherto unknown planet which revolves in an orbit interior to that of Mercury. Such a body, if it does exist, could be well detected during the progress of a total solar eclipse, if the region of the sky in the neighbourhood of the sun was very carefully examined. It may be in the recollection of some of your readers that, on the occasion of the eclipse of August 7, 1869, a bright object was seen by several observers in close proximity to the solar orb, and it is not improbable that this was actually the planet which Lescarbault, on March 26, 1859, witnessed in transit. It is true that observations made of late years, with the special object of detecting this suspected planet in transit over the sun's disc, have been unsuccessful, no object presenting an analogous appearance to a planetary body having been observed passing over the solar surface. This fact, however, does not prove the non-existence of the planet, and it is advisable that observers of the forthcoming eclipse carefully scrutinise the neighbourhood of the sun at the time of totality, so that it may be rediscovered if possible. Several observers of note have, on various occasions, witnessed the partial transit of opaque planetary bodies across the sun, and it does not seem altogether improbable that these bodies are intra-mercurial planets, which, from their proximity to the sun, could never be discerned, except when in transit, or at the time of a total solar eclipse. It is to be hoped that at the time of the approaching eclipse this fact will be considered, and a rigorous search made for the supposed planets, so that they may be discovered, and an increase to our knowledge effected.

I have the honour to be, Sir, your obedient servant,

WILLIAM F. DENNING, Hon. Sec,
Observing Astronomical Society.

Hollywood House, Cotham Park,
Bristol: November 2.

In reference to the foregoing, Mr. William F. Denning has forwarded us the following:—"I have received from two different observers accounts of observations of planetary spots passing over the sun. I do not think these observations have ever been published, and so send them to you for publication, thinking that they may prove interesting, although I cannot vouch for their authenticity. On August 1, 1858, 4h., Mr. Robert Wilson, of Manchester, observed the partial transit of a circular opaque body over the sun. He watched it from 4h. to 5h. 30m., when the observation was interrupted. Its motion was from east to west, across the solar disc, and it presented an appearance very analogous to a planet in transit. The other observation is by Mr. William Waite, of London, who, in a letter to me, states:—'It may interest you to know that, some years ago, I saw, what I suppose must have been, a planetary body in transit across the sun. A dark speck in the lower limb of the sun caught my eye just about sunset; thinking it to be a sun spot, I got a glass to look at it, but found it to be a globular body of the apparent bigness of an ordinary sized marble, and intensely black. I had not time to notice in which direction it was moving, as the sun dipped almost immediately. Unfortunately, I am unable to recollect what year it was in, but it must have been between June, 1860, and June, 1863, and I imagine the season was either spring or autumn, as the house fronted nearly due west, and the sun was setting just opposite. If such things have been seen, they may be seen again; and every additional observation tending to increase such probability leads me to trouble you with this rather lame tale.' It is hardly necessary for me to comment on the foregoing, so I leave your readers to form their own opinion as to what amount of reliance it is entitled to. I would remark, however, that the expression (in regard to the object seen by Mr. Waite) as to its size, is a rather vague one. With reference to the object seen by Mr. Wilson, it would seem that it could not have been the planet that was seen by Lescarbault, inasmuch as it was seen in August 1, whereas it would appear that the latter body can only be observed in transit during the intervals from March 20, April 10, September 27, and October 14, that is, if the rough date supplied by Lescarbault is reliable."

WILLIAM F. DENNING.

SUN.

Greenwich, Noon. 1871.		Heliographical longitude of the apparent centre		Heliographical latitude of the sun's disc.	Angle of position of the sun's axis.
Dec. 1	...	210°·86	—31 δ ξ	... +0°·64 N	... 16°·10
2	...	224·06		... 0·51	... 15·71
3	..	237·25	—29 δ ξ	... 0·38 N	... 15·31
4	...	250·44		... 0·25	... 14·91
5	...	263·64		... +0·12 N	... 14·50
6	...	276·83		... 0·00	... 14·08
7	...	290·02		... —0·13 S	... 14·66
8	...	303·21		... 0·26	... 13·24
9	...	316·41		... 0·39	... 12·81

10	...	329·60	—22 δ ξ	...	—0·52 S	...	12·37
11	...	342·79		...	0·64	...	11·93
12	...	355·98		...	0·77	...	11·49
13	...	9·17		...	0·90	...	11·04
14	...	22·36		...	1·03	...	10·59
15	...	35·55		...	1·15	...	10·13
16	...	48·74		...	1·28	...	9·67
17	...	61·93	—15 δ ξ	...	1·41 S	...	9·21
18	...	75·11		...	1·53	...	8·74
19	...	88·30		...	1·66	...	8·27
20	...	101·49		...	1·78	...	7·80
21	...	114·68		...	1·91	...	7·33
22	...	127·87		...	2·03	...	6·85
23	...	141·06		...	2·15	...	6·37
24	...	154·25	—8 δ ξ	...	2·28 S	...	5·89
25	...	167·43		...	2·40	...	5·41
26	...	180·62		...	2·52	...	4·92
27	...	193·81		...	2·64	...	4·44
28	...	206·99		...	2·76	...	3·95
29	...	220·18		...	2·88	...	3·46
30	...	233·37		...	3·00	...	2·98
31	...	246·55	— δ ξ	...	—3·11 S	...	2·49
'72 Jan 1	...	259·74		...	—3·23 S	...	2·00

MOON'S TERMINATOR.

Greenwich, Midnight			60°N.		0°		60° S.
				Sunset.			
			°		°		°
1871. Dec.	1	...	+33·4	...	+32·8	...	+32·2
	2	...	21·1	...	20·6	...	20·1
	3	...	+9·0	...	+8·5	...	+8·0
	4	...	—3·2	...	—3·7	...	—4·1
	5	...	15·4	...	15·8	...	16·2
	6	...	27·7	...	28·0	...	28·3
	7	...	39·9	...	40·2	...	40·5
	8	...	52·1	...	52·4	...	52·6
	9	...	—64·3	...	—64·5	...	—64·7
				Sunrise.			
	15	...	+42·4	...	+42·3	...	+42·2
	16	...	30·3	...	30·1	...	30·0
	17	...	18·2	...	18·0	...	17·8
	18	...	+6·1	...	+5·8	...	+5·6
	19	...	—6.0	...	—6·3	...	—6·5
	20	...	18·1	...	18·5	...	18·8
	21	...	30·2	...	30·6	...	31·0
	22	...	42·3	...	42·8	...	43·2
	23	...	54·4	...	54·9	...	55·4
	24	...	66·4	...	67·0	...	67·5
	25	...	—78·5	...	—79·1	...	—79·7

SUNSET.

27	...	+75·9	...	+76·6	...	+77·3
28	...	63·7	...	64·4	...	65·2
29	...	51·5	...	52·3	...	53·1
30	...	39·3	...	40·2	...	41·0
31	...	+27·2	...	+28·0	...	+28·9

VARIABLE STARS.

1871.	G. M. T.*						Place of Star 1855. A. R.	Decl.
	h. m.				mag.		h. m. s.	° ′
Dec. 3	5 7	Algol	...	min.				
4		U Virginis	...	—			12 43 45	+6 20·6
13	12 7	S Cancri	...	—	10	...	8 35 39	+19 33·2
14	17 0	Algol		—				
17	13 8	Algol		—				
18		T Piscium	...	max.	9·5	...	0 24 29	+13 48·0
20	10 7	Algol	...	min.				
23	7 5	Algol	...					
—		R. Persei	...	max.	8	...	3 20 50	+35 10·1
—		R. Leporis	...	min.	9	...	4 53 0	—15 1·7
24		R Arietis	...	min.	12·5	...	2 7 53	+24 22·9
25		S Vulpeculæ	...	—	9·5	...	19 42 27	+26 55·7
26	4 3	Algol	...	—				
27		R Sagittæ	...	—	10·0	...	20 7 27	+16 17.4
Jan. 1	12 0	S Cancri		—				

The new Variable in A. R. 23h. 13m. 13s. decl. + 8° 7′ 5″, f. 1855, mentioned at p. 223, appeared on Nov. 6, of about 7m. 5s. Will not some observers, who have the means, please watch its changes?

JUPITER.

G. M. T.		Zenographical longitude | latitude of the centre of ♃'s disc. 8h.	10h.	12h.	14h.	16h.		Angle of pos. of ♃'s axis. 12h.		13h.
1871.		°	°	°	°	°		°		°
Dec. 1	...	9	82	154	227	300	...	0·96N.	...	13·83
2	...	160	233	305	18	90				
3	...	311	24	96	169	241				
4	...	102	174	247	319	32				
5	...	253	325	38	115	183				
6	...	43	116	189	261	338	...	0·95	...	13·72
7	...	194	267	339	52	125				
8	...	345	58	130	203	275				
9	...	136	209	281	354	66				
10	...	287	359	72	145	217				
11	...	78	150	223	295	8	...	0·95	...	13·58
12	...	229	301	14	86	159				
13	...	19	92	165	237	310				
14	...	170	243	315	28	101				
15	...	321	34	106	179	251	...			
16	...	112	185	257	330	42	...	0·95	...	13·41

17	263	335	48	120	193		
18	54	126	199	271	344		
19	205	277	350	62	135		
20	355	68	141	214	286		
21	146	219	291	4	77	0·95	13·22
22	297	10	82	155	227		
23	88	161	233	306	18		
24	239	312	24	97	169		
25	30	102	175	247	320		
26	181	253	326	38	111	0·95	13·00
27	331	44	117	189	262		
28	122	195	267	340	53		
29	273	346	58	131	203		
30	64	137	209	282	354		
31	215	287	0	73	145	0·95N.	12·77

The longitudes are reckoned from the meridian, which on Dec. 31 at midnight appear directed to the earth. The assumed rate of daily rotation is 870°72. The position of the planet's equator is assumed in accordance with Dàmoiseau's tables.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN DECEMBER, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight.	Objects to be observed.
	° ′	
14*	140 9·2	Neper, Schubert, Mare Australe.
15	126 36·4	Berzelius, Schumacher, Trallis.
16	113 23·7	Borda, Colombo, Cook.
17	100 38·9	Mutus. Manzinus, Schomberger.
18	88 19·5	Simpelius, Pentland, Jacobi.
19	76 32·2	Malapert, Curtius, Zach.
20	64 46·8	Mount Bradley, Boscovich, Bessell.
21	53 26·7	Reinhold, Landsberg, Longomontanus.
22	42 19·4	Gassendi (*a*), Doppelmayer, Letronne.
23	31 21·3	Gay Lussac, Carpathian Mountains.
24	20 29·6	Marius, Remer, Hansteen.
25	9 41·5	Drebbel, Fourier, Wiegel.
26	—1 5.2	Eichstadt, Gerard, Lavoisier.

For additional objects consult the lists for August and October.

* Autumnal Equinox, N. hemisphere.

(*a*) Gassendi. See notice in list for November, *ante*, p. 270.

Plato.—It is desirable to examine the floor with instruments of larger aperture than 9 inches. A minute spot just west of the principal spot No. 1. was seen by Mr. Gledhill with 9⅓ inches aperture, in January, February, and March, 1870. He does not appear to have seen it since the 13th of March in that year, when he described it as an easy object.

Errata.

October 28. For *rock,* read *rook.* Fourth line from 28, for *part of* read *parts of.*

November. For *Œnopedes,* read *Œnopides.* Note (*c*). for *Bandell,* read *B and M.* Note (*g*). for *Procus,* read *Proclus.*

ENCKE'S COMET.

This object is passing beyond reach of telescopes, owing to its approach to the sun. The following positions given by Glasenapp are not very exact; they place the comet about ½° too much to the N.

1871.		R.A. h. m. s.		° ′	Decl. ° ′
Dec. 1	...	18 31 46	...		+4 28
3	...	12 18 19 35	...	2 33	+1 55
5	...	12 18 7 56	...	2 27	−0 32

OCCULTATION OF VESTA.

Mr. Hind, in a letter to the *Astronomische Nachrichter,* notes that on Dec. 30, Vesta will be occulted by the moon. He does not remember to have met with any observed occultation of a minor planet. For Greenwich the circumstances on Dec. 30 are as follows:

		h. m.		°
Immersion	...	10 44	...	89 N. P. Aagle.
Emersion	...	11 51	...	240

New Comet.—A new comet was discovered by M. Tempel, at Marseilles, on November 3. The comet which was round and about 2½′ in diameter, was at the time of its discovery passing southwards out of reach.

The following positions may be acceptable to some of our readers residing out of England:

1871.		R.A h. m. s.		Decl. ° ′
Dec. 1	...	18 50 6	...	−34 2
5	...	18 51 36	...	37 4
9	...	18 52 30	...	−40 2

The following elements, calculated for direct motion, are by M. Ofpolzer:

		°
Perihelion Passage	Dec. 20 =	115 B.M.T.
Longitude of Perihelion	=	22 25
Longitude of Ascending Node	=	145 19
Inclination	=	102 7
Log. q.	=	9·87628

These elements resemble those of more than one previous comet, but they are too provisional to make it safe to draw any conclusions.

A New Observatory.—We hear that Professor Alluard, of Clermont-Ferrand, has obtained a grant of the necessary fnnds for establishing his long projected Observatory on the summit of the Puy-de-dome.

DATE.		Principal Occurrences. h. m.		Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m. Aldebaran
Fri	1	18 8	Occultation of γ Cancri (4½)	1st Sh. E.	8 20	11 47·1
		19 20	Reappearance of ditto	1st Tr. E.	9 19	
		4 30	Conjunction of Moon and Jupiter, 2° 57′ S.			
		7 25	Conjunction of Moon and Uranus, 2° 44′ S.			
Sat	2		Sidereal Time at Mean Noon, 16h. 43m. 33s.	2nd Oc. R.	11 57	11 43·1
Sun	3	17 32	Occultation of 42 Leonis (6)			11 39·2
		18 48	Reappearance of ditto			
Mon	4	18 45	☾ Moon's Last Quarter	3rd Ec. D.	8 50 40	11 35·3
				3rd Ec. R.	12 5 47	
				3rd Oc. D.	12 30	
				3rd Oc. R.	16 0	
Tues	5		Sun's Meridian Passage, 9m. 17·84s. before Mean Noon	4th Ec. R.	9 20 15	11 31·3
				4th Oc. D.	14 10	
				1st Ec. D.	16 10 37	
				4th Oc. R.	18 21	
Wed	6			1st Sh. I.	13 26	11 27·4
				1st Tr. I.	14 20	
				1st Sh. E.	15 45	
				1st Tr. E.	16 29	
Thur	7	16 35	Occultation of 80 Virginis (6)	1st Ec. D.	10 38 57	11 23·5
		17 17	Reappearance of ditto	1st Oc. R.	13 49	
				2nd Sh. I.	14 23	
				2nd Tr. I.	16 10	
				2nd Sh. E.	17 17	
Fri	8	5 22	Conjunction of Moon and Venus, 1° 51′ S.	1st Sh. I.	7 55	11 19·5
			Saturn's Ring :	1st Tr. I.	8 46	
			Major Axis=34·29″	1st Sh. E.	10 14	
			Minor Axis=14·83″	1st Tr. E.	11 6	
Sat	9	18 19	Occultation of ζ^1 Libræ (4)	1st Oc. R.	5 7 21	11 15·6
		19 13	Reappearance of ditto	2nd Ec. D.	9 22 24	
				2nd Oc. R.	13 59	
Sun	10		Conjunction of Mercury and λ Sagittarii (12·8m) W.			11 11·7
			Conjunction of Venus with κ Virginis (3·8m.) E.			
Mon	11	16 1	● New Moon	2nd Tr. E.	8 15	11 7·7
			Eclipse of the Sun, invisible at Greenwich	3rd Ec. D.	12 48 41	
		15 45	Conjunction of Saturn and Mercury, 2° 26′ S.	3rd Oc. R.	19 27	
Tues	12	23 30	Conjunction of Moon and Saturn, 2° 4′ N.	1st Ec. D.	18 4 3	11 3·8
Wed	13	2 1	Conjunction of Moon and Mercury, 0° 16′ S.	4th Sh I.	13 48	10 59·8
				1st Sh. I.	15 20	
				1st Tr. I.	16 6	
				1st Sh. E.	17 39	
				4th Sh. E.	17 41	
				1st Tr. E.	18 25	
Thur	14	5 6	Conjunction of Moon and Mars, 1° 57′ N.	1st Ec. D.	12 32 25	10 55·9
				1st Oc. R.	15 34	
				2nd Sh. I.	16 57	
				2nd Tr. I.	18 28	
				2nd Sh. E.	19 51	
Fri	15		Illuminated portion of disc of Venus=0·545	3rd Tr. E.	9 9	10 52·0
			„ Mars=0·954	1st Sh. I.	9 49	
				1st Tr. I.	10 32	
				1st Sh. E.	12 8	
				1st Tr. E.	12 52	
Sat	16			1st Ec. D.	7 0 50	Moon.
				1st Oc. R.	10 0	[illegible] 23·5
				2nd Ec. D.	11 58 [illegible]	
				2nd Oc. R.	16 [illegible]	

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sun	17		Sidereal Time at Mean Noon, 17h. 42m. 41·37s.	1st Sh. E. 1st Tr. E.	6 36 7 18	5 15·2
Mon	18	8 41 9 0 10 2	☾ Moon's First Quarter Occultation of 30 Piscium (5) Reappearance of ditto	2nd Tr. I. 2nd Sh. E. 2nd Tr. E. 3rd Ec. D.	7 36 9 9 10 31 16 47 23	6 2·8
Tues	19		Sun's Meridian Passage 3m. 46·31s. before Mean Noon.	1st Ec. D.	19 57 36	9 47·7
Wed	20	12 49 13 23	Occultation of ν Piscium ($4\frac{1}{2}$) Reappearance of ditto	1st Sh. I. 1st Tr. I. 1st Sh. E.	17 14 17 51 19 33	7 31·0
Thur	21			1st Ec. D. 1st Oc. R. 2nd Sh. I.	14 25 59 17 19 19 32	8 14·0
Fri	22			3rd Tr. I. 4th Oc. R. 3rd Sh. E. 1st Sh. I. 1st Tr.. I. 3rd Tr. E. 1st Sh. E. 1st Tr. E.	9 0 9 15 10 8 11 43 12 17 12 31 14 2 14 37	8 57·5
Sat	23			1st Ec. D. 1st Oc. R. 2nd Ec. D. 2nd Oc. R.	8 54 26 11 45 14 35 18 35	9 42·2
Sun	24	18 11 19 2	Occultation of ι Tauri (5) Reappearance of ditto	1st Sh. E. 1st Tr. E.	8 30 9 3	10 28·6
Mon	25			2nd Sh. I. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E.	8 49 9 51 11 43 12 46	11 16·8
Tues	26	9 34	○ Full Moon			12 6·1
Wed	27			2nd Oc. R. 1st Sh. I.	7 43 19 8	12 56·0
Thur	28	5 18 6 8 6 6	Occultation of μ^1 Cancri Reappearance of ditto Conjunction of Moon and Jupiter, 2° 41′ S. Conjunction of Moon and Uranus. 2° 43′ S. Saturn's Ring: Major Axis=34·04 Minor Axis=14·49	1st Ec. D. 1st Gc. R.	16 19 41 19 3	13 45·5
Fri	29			3rd Sh. I. 3rd Tr. I. 1st Sh. I. 1st Tr I. 3rd Sh. E. 3rd Tr. E. 1st Sh. E. 1st Tr. E.	10 41 12 19 13 37 14 1 14 7 15 49 15 56 16 21	Aldebaran — 9 56·9
Sat	30			4th Sh. I. 1st Ec. D. 4th Tr. I. 4th Sh. E. 1st Oc. R. 4th Tr. E. 2nd Ec. D.	7 47 10 48 11 11 21 11 46 13 29 15 35 17 11 29	9 53·0
Sun	31			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	8 5 8 27 10 24 10 47	9 49·1

THE PLANETS FOR DECEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	17 36 12	—25 37	5″·2	0 56·5
	15th	18 59 18	24 36	6″·6	1 24·3
Venus ...	1st	13 28 33	—6 57	25″·8	20 45·5
	15th	14 24	11 25	22″·2	20 46·0
Jupiter ...	1st	8 7 5	+20 34½	40″·7	15 24·9
	15th	8 2 57	20 49	42″·1	14 25·8
Uranus ...	15th	8 11 49	+20 36	4″·2	14 34·6
Neptune ...	3rd	1 22 7	+6 46½	1″·6	8 33·3
	15th	1 21 32	6 43½	0″·8	7 45·4

Mercury will be well situated for observation towards the middle of the month, setting then about 1h. 30m. after sunset; from the 22nd the interval decreases to half-an-hour at the end of the month.

Venus is a morning star, rising about 4h. before the sun throughout the month, and is well situated for observation.

Jupiter is excellently situated for observation, being visible for the greater part of the night towards the end of the month; on the 1st he rises about 4¾h. after sunset, the interval increasing to 3¾h. on the 27th.

TUTTLE'S COMET.

1871.		R. A. h. m. s.		Decl. °
Dec. 1	...	11 2 23	...	—27 44·3
2	...	11 4 55	...	29 30·9
3	...	11 7 31	...	31 15·7
4	...	11 10 8	...	32 58·7
5	...	11 12 45	...	34 39·6
6	...	11 15 26	...	36 18·2
7	...	11 18 11	...	37 54·2
8	...	11 20 58	...	—39 27·2

DYNAMETER OR DYNAMOMETER.—The little instrument for measuring the power of eye-pieces, introduced by Mr. Berthon, is entitled a *dynamometer;* I remember that in former works on astronomy an instrument was described called a *dynameter*. I should like to know which is the right appellation, or if either instrument is adapted for the same purpose.—QUERY.

[Dynamometer is the right way of spelling the word (δυναμις, power; and μετρον, a measure).—EDITOR.]

PHILOSOPHY NOT SCEPTICAL.

"There are, doubtless, philosophers and astronomers, who in their mathematical and astronomical investigations leave out of the great problem of nature the very being of God. This, indeed, in the very nature of things they are compelled to do. No power of analytical grasp, no refinement of infinitesimal arithmetic can reach the being and attributes of God. The philosopher and mathematician is compelled to begin exactly where Moses left off. 'In the beginning God created the heavens and the earth,' says Moses, and, admitting this declaration, the philosopher undertakes to discover the plan according to which this creaton was effected, and by means of which it is now maintained. The sun, the moon, the planets, the comets, the stars, exist; they roll and shine, measuring time by their mighty revolutions, and filling space by their sublime orbits. There they are as God created them, and the philosopher simply inquires, according to what laws do they move? What reciprocal influences do they exert? What are the forms and limits of their mighty orbits? What the sublime periods of their march through space? What the nature of the dynamic equilibrium which links them into groupings of surpassing grandeur?

"It is true that in all these investigations the very being of God may be forgotten. For the lawgiver we may substitute the laws. Gravitation may supersede in mathematical research the omnipotence of God. No laws of motion, simple, invariable, eternal, may stand for that attribute of Jehovah's will which changeth not, the same yesterday, to-day, and for ever. The sun himself may be shorn of his effulgence: his light, and heat, and life may shrink and fade beneath the withering breath of philosophy, and this mighty and glorious orb become a material heavy point, and all the revolving planets and their moons other material heavy points, at definite distances and with determinate weights, and thus the will of God, as manifested in His laws, and the very creations of God as exhibited in his suns, and systems, and moving worlds, become the mere hypotheses and material points in the diagram of the mathematician's slate,—and what then? Does this destroy God and his attributes? Does this blot out of the heavens the blazing sun? Does this strike from being planet, and moon, and earth teeming with life, and hope, and joy, and love, and immortality?—Never! They all remain: while the geometer grapples these wondrous orbs in their weight, dimensions, distances, and motions, with his sublime analytic machinery, and with gigantic intellectual power follows their grand career,—the problem solved, the orbit figured, the period predicted,—all, all proclaim the being of God, the unchangeableness of the laws of His physical government, and the grasp of thought with which He has endowed His own image, into whose nostrils He breathed the breath of life. It has been truly sung:

> 'The undevout astronomer is mad,'—

and yet, alas! we are compelled in a few instances to confess, that this madness has filled the hearts of some whose names have been written in letters of living light on the very circle of the heavens. I say a few instances, for by far the greater number of the heroes of science are to be counted among the devout; Copernicus, and Kepler, and Tycho, and Galileo, and the prince of philosophers, Newton the immortal—all looked through nature to nature's God. Kepler, in all his grand investigations, commenced his daily toil by invoking the aid of Divine wisdom, and Newton's reverence was so great, that he never uttered the name of God without reverently lifting his hand to his head, feeling the immediate

presence of the divinity in His material works. And, yet, these are the greatest names which the annals of astronomy and science can boast,—their investigations were more profound, their mathematics deeper than most of those could boast, who are now compelled to acknowledge themselves humble followers of these great luminaries. We say, then, that while in minds especially framed for pure *physical* research, there is a tendency to an undue preponderance of mathematical reasoning, the abstractions of science, and the mathematics of astronomy, do not of necessity lead to scepticism."—Mitchell, *Astronomy of the Bible*.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.	To March, 1872.	To Dec. 1872.
Broughton, S.	Mills, E. B.	Gould, Rev. J.
Buckingham, J.		Hollis, H. W.
D'Alquen, F. M.	**To April, 1872.**	
Darby, Rev. W.		**To Feb. 1873.**
Harris, Rev. C. S.	Lowson, D. L.	
Jenkinson, J. H.		Leigh, J.
London Institution.	**To June, 1872.**	
Matthews, W.		**To Dec., 1873.**
Walton, T.	Howlett, F.	
Woodman, T. C.	Strange, Col.	Lawrence, E.

Errata. No. 107, p. 249, line 4, for LYRÆ, read LYRA.

Books received.—Mr. Williams, "Chinese Observations of Comets," Seventh Report of the Board of Visitors to the Observatory, Victoria. Symon's *Meteorological Magazine*, Denning's Astronomical Phenomena for 1872.

TO CORRESPONDENTS.

It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

Our correspondent of Eastfield, Bolton, making enquiries for instruments, omitted to send his name.

We are obliged to postpone several interesting matters for want of space.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

Arabic names of Stars & Constellations see page end of vol. 8.

THE

ASTRONOMICAL REGISTER:

A MEDIUM OF COMMUNICATION
FOR AMATEUR OBSERVERS, AND ALL OTHERS INTERESTED IN THE
SCIENCE OF ASTRONOMY.

VOL. X.

NOS. 109 TO 120: JANUARY TO DECEMBER, 1872.

LONDON:
J. D. POTTER, 31, POULTRY, & 11, KING STREET, TOWER HILL.
1873.

LONDON:
ALABASTER AND PASSMORE, 31, LITTLE BRITAIN, E.C.
1873.

THE ASTRONOMICAL REGISTER.

INDEX TO VOLUME X.

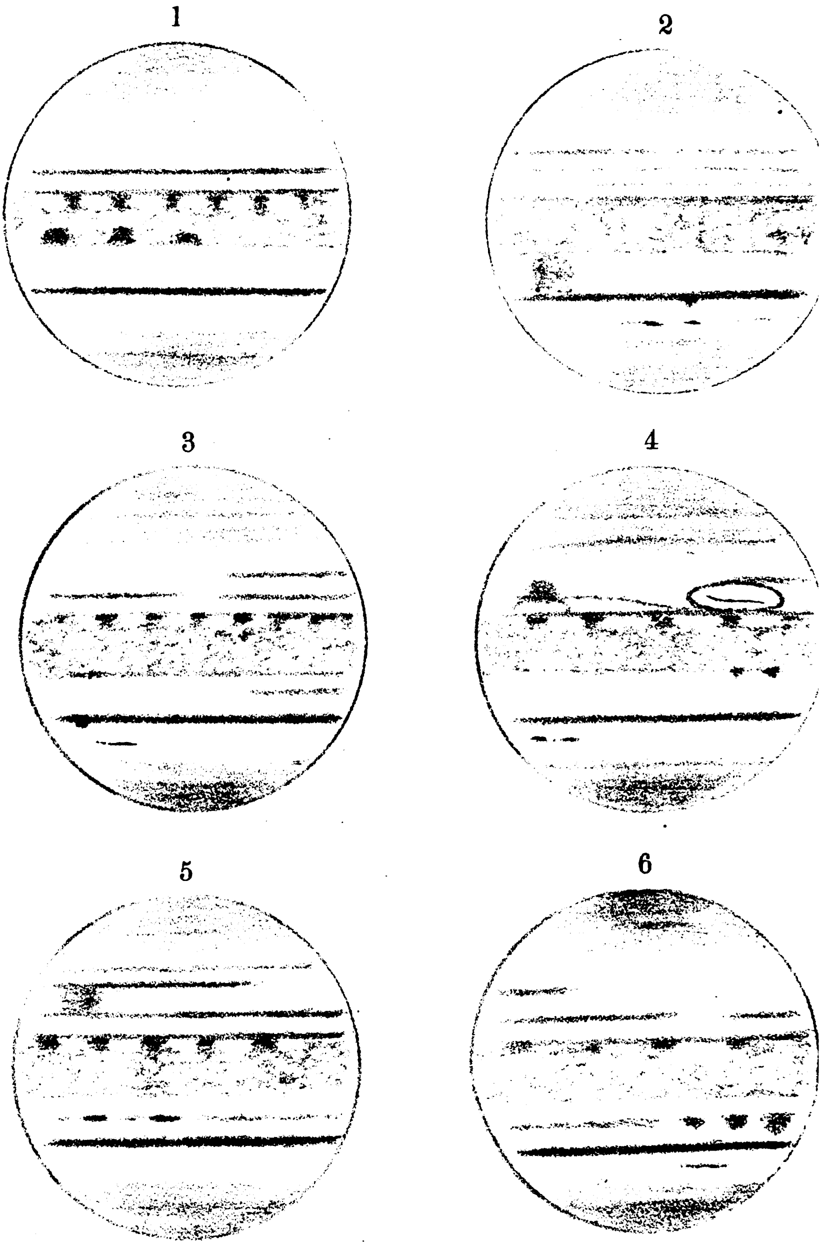
Names of New Subscribers, Instruments for Sale, &c.
Notices to Correspondents, &c., &c.

APPENDIX.

The Observing Astronomical Society. See [illegible] p. 156
The Hackney Scientific Association.

ENGRAVINGS.

JUPITER 1871.



Mr. E. Crossley's Observatory, Park Road, Halifax.

The Astronomical Register.

No. 109. JANUARY. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Second Meeting, December 8th, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. Thirty-four presents were announced, and the thanks of the Society voted to the respective donors.

E. G. Monk, Esq., and
Duncan Darroch, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Observations of Tempel's Comet: by Mr. Hind.

Elements and Ephemeris of the same: by the same.

Ephemeris of Tuttle's Comet for the Southern Hemisphere: by the same.

Occultation of Vesta by the Moon: by the same.

This will occur on December 30, the immersion at 10h. 44m., G. M. T., and the emersion at 11h. 52m. G. M. T. There is no record of any similar occurrence before.

Mr. Dunkin said that it would be useless to look for the immersion which happened at the bright limb of the moon, as the light there was sufficient to obscure 6th magnitude stars before the occultation, and Vesta only appeared of the 7th magnitude, but with fair telescopes the reappearance at the dark limb might be looked for.

On the Floor of Plato: by Mr. Birt.

The author had suspected that the sun produced a darkening effect on the floor of Plato, and upon examining 133 observations by different observers he found this idea confirmed. He had projected the result graphically into a light curve, accompanied by one of the sun's altitude, which showed that after sunrise the tint darkened to the meridian elevation, and then lightened again.

Capt. Noble wished to know how the tints were compared?

Mr. Birt: By estimating them as light or dark, and as compared with the adjoining Mare Imbrium.

Capt. Noble: But that surface would be similarly affected. You want something external. Was your *Homochromoscope* used?

Mr. Birt: No. The tints were derived from the estimations given by the different observers.

The President: Do you not want a standard of comparison in order to project your curve with accuracy?

Mr. Birt: It would be desirable, but the investigation has not proceeded far enough at present. It is quite clear there is a difference according to the solar elevation. I have noticed this for 11 years, but never had materials for a curve before.

Capt. Noble suggested the employment of a wedge of coloured glass with a graduated edge to measure the tints.

Mr. Birt: Nothing could be better, but it is difficult to get observers to use it.

On the Spectrum of Hydrogen at low Pressures: by Mr. Seabroke.

The author during the summer has been comparing the lines of Hydrogen and the Sun, to see if there were any more lines due to that gas in the *chromosphere* than those already known. His experiments were made at the Rugby Observatory. The hydrogen tube was connected with a Sprengel pump, and the pressure reduced to 3 or 4 m m of mercury; a battery and coil being used to pass the sparks through the gas. The room was darkened and sunlight obtained when required by reflection from a heliostat in the roof. The light of the spark was concentrated by a lens on the slit of the spectroscope (which consisted of 4 prisms of

60°) and passed twice through the train. Twenty-one lines were examined, but only the C and F hydrogen lines were found to coincide with any in the chromosphere. In making this statement a line near *g* and the line *h* which are known to be due to hydrogen are not included.

Occultation of ε Capricorni by the Moon, on Nov. 18, 1871: by Capt. Noble.

The star disappeared instantaneously at the dark limb of the moon at 22h. 52m. 31·3s. L. S. T.=7h. 3m. 0·7s. L. M. T., and reappeared pretty sharply at the bright limb at 23h. 39m. 8s. L. S. T.=7h. 49m. 38·9s. L. M. T. The star being low there was a good deal of undulation.

Eclipse of Jupiter's Third Satellite, on Dec. 4, 1871: by Capt. Noble.

It is impossible to say exactly when the light was first diminished, as it took several minutes to fade out. The last glimpse was at 1·18·7. Capt. Noble thinks it should be settled what *is* the eclipse, whether when the fading begins, when the satellite is dichotomized, or when it finally disappears. The latter will not do, as it would be seen so much longer in large telescopes than in small ones. He also again adverted to the inaccuracy of the tables.

The President: The *Nautical Almanack* tables of Jupiter's phenomena were not intended for large telescopes.

Capt Noble: That is true, but it is not the question. I want to know why Damoiseau's Tables, which are admittedly incorrect, are still used in the computations for the *Nautical Almanack*.

Mr. Dunkin: The Society ought to be very much obliged to Capt. Noble for calling attention to the errors of Damoiseau's Tables. It is easy to say compute new ones, but not so easy to do. With respect to the time of disappearance I have probably seen as many of these eclipses as most people, and I take the disappearance to be when I cannot see the satellite any longer, and the reappearance to be when the first faint light appears which gradually grows stronger. The tables were certainly intended to be used with telescopes of small aperture. The *Nautical Almanack* is a wonderful work, and the errors are very small indeed in most cases. Even in using these eclipses for the determination of longitude, the present tables would give it within a quarter of a degree as well as the best tables that ever could be made. The errors with the 1st and 2nd satellites which move slowly are very small, with the 3rd they are greater, and the 4th has been even twenty minutes out, but eclipses of this satellite are very scarce indeed. We saw one lately, and I was surprised to find the error was only two minutes.

Capt. Noble: That was only a fluke. When we compared the *Nautical Almanack* with the Greenwich Observations here on a former occasion, we found an error of 19s. with the 1st satellite. Now these eclipses are very sharply seen, and I contend that they could be used for getting the longitude with telescopes of given dimensions, and errors of 19 seconds ought not to occur.

Mr. Dunkin: The observations at present are made with apertures from 3 to 13 inches. With the equatorial, the satellite is seen later, and again earlier than with anything else.

Note on the November Meteors: by Capt. Noble.

During his watch from 12h. to 1h. 15m., on November 13, the author failed to see a single meteor.

Mr. Glaisher said that every minute of the nights of November 13 and 14 was watched by the Greenwich observers, and they only saw 30 meteors in the whole time. Captain Noble's observation was important as showing that we were now well out of the stream of meteors, and not likely to see many for nearly 30 years. As to Jupiter's satellites, the *Nautical Almanack* represented the tables of the time, and although materials for improving them existed, it could not be said it was Mr. Hind's duty to calculate new ones. It was much to be regretted we generally left foreigners to discuss the results of our excellent observations.

Mr. Ranyard suggested that to rely on such observations, we wanted not only a fixed aperture, but a fixed amount of cloud, and a fixed altitude of Jupiter.

The President: It would require the mean of observations by a number of observers, through a series of phenomena, before we could say the *Nautical Almanack* failed to do what it professed.

Capt. Noble: I am not saying the almanack is not well computed; but why are not the tables corrected? If not Mr. Hind's business, I should like to know whose it is?

Professor Cayley suggested that we wanted another thing. The book represented existing tables, and observations should be obtained for comparison, before attempting to alter it.

Capt. Noble: We want some German, Swede, or other foreigner to make tables which no Englishman can or will do.

Mr. Ranyard: Even with a standard telescope, differences of altitude or other circumstances would make a difference of 1-8th of a degree of longitude.

Mr. Dunkin said that to make the *Nautical Almanack* a perfect production, the tables of all the bodies must be recomputed. Even the moon sometimes differed from its computed place a second, and it might be different another time, so that a table of corrections had to be used. He thought that the Germans would soon produce new tables of Jupiter, Saturn, and Uranus.

On the Geodesic lines in an Ellipsoid: by Professor Cayley.

The author explained this paper orally, illustrating his remarks by a diagram.

Rev. J. C. Jackson read a letter from Mr. Gledhill, accompanying a drawing of *Jupiter* which was exhibited to the meeting. In 1869, Mr. Gledhill observed a remarkable elliptical formation on the planet which had now reappeared. The drawing was made on December 1, 1871, about 11h. 30m., G. M. T., with an achromatic telescope of 9¼ inches aperture and power of 240. The ellipse was situated just to the south of Mr. Gledhill's band 4 and was 15″ in length. Its shape was regular, and it was preceded by a large whitish spot on the same parallel. It seemed the same configuration as seen before, or else one exactly like it. There appeared to be some connection between this form and the small white spots.

Capt. Noble saw the small white spot last month with his telescope of 4·2 inches aperture.

Mr. Ranyard said that Mr. Gledhill had sent him a copy of the drawing in which was a curious spot like a pipe. This also had been seen before at the same time as the ellipse.

Mr. Proctor exhibited and described his original *chart of* 324,198 *stars*. He said that Mr. Brothers had given an account of its preparation and the labour involved, but that was the least part of its importance. Its real use was in assisting us to form proper views of the construction of the heavens. With regard to the objection that the constellations were not readily detected, that was entirely obviated by the accompanying small chart of the configurations.

On Mr. Abbott's imagined discovery of great changes in the Argo Nebula: by Mr. Proctor.

The author being at a loss to understand the conflicting statements on this subject, and the great discrepancies between Mr. Abbott's drawings and those of Sir J. Herschel, had examined them carefully, and believed that he had ascertained the cause to be the difference of scale between the representations. Mr. Abbott's drawings are made with a small telescope, showing a field of 1° 7′ 42″, while Sir J. Herschel's include very much less of the nebula at any one moment. The effect of this is that the *lemniscate*, which is so marked a feature in the Cape drawings, is in Mr. Abbott's only ¼ of an inch long, and is therefore hardly recognisable.

The Orion Nebula, if treated in the same way, could never be identified with the one drawn by Lord Rosse, or with other large telescopes.

On the Motion of Matter projected from the Sun, with special

reference to the outburst witnessed by Professor Young: by Mr. Proctor.

Such outbursts as that described by Professor Young have also been seen by Secchi, and the accounts show that such statements may be relied on. Professor Young saw a prominence throw out wisps of hydrogen, rising from 100,000 miles to 200,000 miles in ten minutes. The author had calculated the velocity of the gas, which he found would be 212 miles per second if projected into a vacuum, in which it would take 25m. 56s. to travel the distance, but as it rose in ten minutes, the velocity must have been much greater, notwithstanding the retardation of the surrounding gases or vapours. He had used a graphical mode of construction, which showed how a body fell towards the sun in successive periods, and the ascent was the reverse of this. He thought the truth was that the gas ascended more than 200,000 miles, probably as much as 350,000, with a velocity of 255 miles a second. To cause hydrogen to be flung through an atmosphere, it would require a much greater velocity than that last mentioned, probably as much as 1,000 miles per second. A velocity of 379 miles a second would carry the hydrogen clear away from the sun, but we know that it is not so thrown off. May not the hydrogen carry up with it denser particles, and is it not likely or certain that these vapours, having greater density, and therefore greater velocity, would pass clear away from the sun, and might become part of the corona? The paper also referred to the probability of connection between the outbursts and any magnetic disturbances. Nothing occurred at the time at Greenwich, but at Kew five hours after there was a disturbance, although this might not have been caused by the outburst. The prominence was seen not on the photosphere, but at the edge of the sun, so that as Sir J. Herschel had remarked, in a letter written last March, it was no wonder the indications of the magnets did not occur at the same time but afterwards.

Mr. Ranyard said Professor Stokes had suggested that the polarization of the corona might be due to the precipitation of very small particles thrown up from the sun. He thought magnesium dust might be such a body, and would thus account for the radial polarization of the corona.

Mr. Glaisher said that never since the outburst seen by Mr. Carrington and Mr. Hodgson, when the magnets were affected simultaneously, had he been able to trace any connection between the magnetic disturbances and solar phenomena, although it had been diligently watched for. On the occasion of Professor Young's observation, he had supplied copies of the Greenwich magnetic curves, but nothing could be detected bearing on the supposed connection.

Capt. Noble compared the velocity of 212 *miles* a second with that of a cannon ball, viz., 1,300 *feet* in the same time, and said it was impossible to realize such a rate of motion.

Note on an especial point in the determination of the elements of the Moon's Orbit, from Meridional Observations of the Moon: by the Astronomer Royal.

Mr. Dunkin explained that this paper referred to the extreme difficulty in determining the semi-diameter of the moon. At one time of the year the observer has to take the N. limb of the moon, and during the other half-year the S. limb. The author thinks that in his former paper on the corrections of the moon's orbit, there is a small term which requires alteration, in consequence of an erroneous value having been used for the moon's semi-diameter.

Capt. Noble: It is a question of irradiation. No one ever saw the real edge of the moon's disc.

On Encke's Comet: by Mr. Hollis.

This paper was accompanied by a drawing made with an 8 inch achromatic, and power of 120, on November 12. From the sharpness of the two edges, and their brightness as compared with the interior, the author thought the comet was a hollow cone. He had tried to measure the angle included, and found it about 86°.

Dr. Huggins: The sides of the comet in this drawing are straight, but in Mr. Carpenter's and mine they are decidedly curved. I estimated the angle at something under 90°, and so far I agree with Mr. Hollis, but the two sides of the fan are not straight. On December 5, I caught glimpses of an indication of a tail. A very faint ray was projected from the apex, which is turned away from the sun.

Capt. Noble saw this on the same evening with his $4\frac{1}{4}$-inch object glass.

Mr. Dunkin: Then this prolongation is a true tail?

Capt. Noble: I also saw on Sunday night the gaseous spectrum of the comet with one of Browning's beautiful star spectroscopes.

Lunar Occultations and Eclipses of Jupiter's Satellites: by Mr. Tebbutt.

Reply to Notes and Queries, made by the Astronomer Royal, on the Observations of η Argus: by Mr. Abbott.

Note on the Universal Equatorial: by Mr. Browning.

Elements of Minor Planet (116): by Dr. Luther.

Formules pour le calcul des orbites des etoiles doubles: by M de Gasparis.

The meeting then adjourned.

ENCKE'S COMET.

Encke's comet has been well observed during the past month. By the kindness of the council of the Royal Astronomical Society, we are enabled to give our subscribers a beautiful picture of it as seen at the Royal Observatory at Greenwich.

Since the communication of the Astronomer Royal to the Society, of which we gave an account in last month's report, several persons have noticed that the comet was throwing out a tail from the side opposite to the fan. We refer our readers to an interesting letter from Mr. Knobel upon the subject, with a woodcut illustration, in our correspondence.

THE ECLIPSE OF THE SUN.

The following telegrams have been received :—

"From N. R. Pogson, Esq., at Avenashy, to the Astronomer Royal, Royal Observatory, Greenwich.

"Weather fine. Telescopic and camera photographs successful. Ditto polarisation. Good sketches. Many bright lines in spectrum.

Dec. 12th."

The following is a copy of a telegram received by Mr. William Huggins from Colonel Tennant, F.R.S., who is in charge of the Indian Eclipse expedition :—

Dodabetta, Ootacamund, Dec. 12th, 9.15 a.m.

Thin mist. Spectroscope satisfactory. Reversion of lines entirely confirmed. Six good photographs."

The sentence, "Reversion of lines entirely confirmed," refers to an important observation of Professor Young in Spain, last December, who saw at the moment of total observation all the dark Fraunhofer lines reversed—that is bright on a dark ground.

Upon which Dr. Huggins in the *Times* remarks :—

"Your readers will remember that you inserted a few months since an account of the preparations which were being made by this expedition.

"The sentence, 'Reversion of lines entirely confirmed,' refers to a very important observation made in Spain last December by Professor Young. This observation was described at the time by Professor Langley, one of the American party, in the following words :—

"'With the slit of his spectroscope placed longitudinally at the moment of obscuration, and for one or two seconds later, the field of the instrument was filled with bright lines. As far as could be judged during this brief interval, every non-atmospheric line of the solar spectrum showed bright, an interesting observation confirmed by Mr. Pye, a young gentleman whose voluntary aid proved of much service. From the concurrence of these independent observations, we seem to be justified in assuming the probable existence of an envelope surrounding the photosphere, and beneath the chromosphere, usually so called, whose thickness must be limited to two or three seconds of arc, and which gives a discontinuous spectrum consisting of all, or nearly all, the Fraunhofer lines showing them, that is, bright on a dark ground.'

"Professor Young adds :—

"'Secchi's continuous spectrum at the sun's limb is probably the same thing modified by atmospheric glare ; anywhere but in the clear sky of Italy so much modified, indeed, as to be wholly masked.'"

Lord Lindsay, in the *Daily News*:—

"I have received the following telegram from Mr. Davis, photographer, who accompanied Mr. Lockyer's party to Ceylon:

"'Five totality negatives, Extensive corona, Persistent rifts, Slight external changes.—Mangalore Bekul.' I am, sir, your obedient servant,

Dun Echt, Aberdeen, Dec. 12. LINDSAY."

REVIEWS.

***Observations on Comets from B.C.* 611 *to A.D.* 1640.** Extracted from the Chinese Annals by John Williams, F.S.A., Assistant Secretary of the Royal Astronomical Society. London: Printed for the Author, 1871.

This is an extraordinary book, and well worth careful reading and consideration. A discrepancy in M. E. Biot's description of the comet of October 25, 1366, caused Mr. Williams carefully to examine Biot's catalogue, which led him to conclude, that though accurate in its details, it was not sufficiently complete, and determined him to bring out a complete list of all the observations of comets recorded in the Encyclopædia of Ma Twan Lin, and in the great astronomical work called the *She Ke*. This was his main purpose, but as he went on, many interesting subjects occurred relating to Chinese astronomy, which have been incorporated into his introductory remarks.

Appended are some very valuable tables by which the Chinese time can be reduced to one reckoning, consisting of a complete set of chronological tables, giving the succession of dynasties and Emperors from the earliest period to the present time, and other tables for finding the months or moons and days.

These Tables cannot fail to be of great value to other persons as well as astronomers. At the end of the work is a Chinese celestial atlas, in which the names and positions of the asterisms and stars can readily be found.

If we may trust the antiquity of the books from which the information is gained, and Mr. Williams sees no reason to consider them less reliable than the early histories of any countries; the Chinese possessed considerable astronomical knowledge in very ancient times. "It must, however, be borne in mind that the correctness of the account given entirely depends upon the degree of credence to be placed in the *Shoo King*," (one of their five classical works, which is considered by the Chinese as their most ancient book, and which we know, as revised by Confucius about the sixth century B.C. Its antiquity is not only believed in by the Chinese themselves, but by some of the best European sinologists, and is borne out by its archaic style and construction).

Mr. Williams mentions several tests by which the accuracy of these accounts may be verified. One of the most interesting is the following: —"In the Chinese annals it is recorded, that in the reign of Chuen Kuh, the grandson of Hwang Te, in the spring of the year, on the first day of the first moon, a conjunction of the five planets occurred in the heavens in Ying Shih. Ying Shih, or as it is more usually denominated Shih, is one of the 28 stellar divisions determined by α, β, and other stars in Pegasus, extending north and south from Cygnus to Piscis Australis, and east and west 17 degrees, and comprising parts of our signs Capricornus

and Aquarius. The Emperor Chuen Kuh is said to have reigned 78 years, from B.C. 2513—2436, and to have died in his 95th year, and from modern computations (I believe by M. Bailly, the French astronomer,) it has been ascertained that a conjunction of the five planets actually did take place about the time and within the limits indicated, *i. e.* on the 29th of Sep. 2449 B.C., being the 65th year of Chuen Kuh. Should this on further investigation prove correct, it will afford a strong presumption of the authenticity of the early Chinese annals, as there is no appearance of their astronomers having been at any time able to compute the places of the planets so far back, and the account is found in works published long before any intercourse with Europeans had taken place."

Assuming the authenticity of the *Shoo King*, of which Mr. Williams thinks there can be little doubt, the Chinese had made great progress in astronomy between two and three thousand years before the Christian era. They were acquainted with the true length of the year, they observed the equinoxes and solstices, they had discovered the necessity of frequent intercalations of moons or months, to keep their seasons in their true places, and were able to perform the computations necessary for the purpose. together with many other facts, proving the high degree of knowledge of astronomy to which they had attained.

The observations of comets extend from B.C. 611 to A.D. 1621. The book is one of great interest, and we may add that great credit is due to Messrs. Strangeways and Walden for the excellence of the printing.

Astronomical Phenomena in 1872: by W. F. Denning. This pamphlet consists of certain tables taken from the *Nautical Almanack*, with a few introductory remarks upon the subject of astronomical observations in general. We think the compiler was ill-advised to fix the price at two shillings, as there are many popular almanacks, containing much more information, to be had for a shilling or less, and even the *Nautical Almanack* itself costs but half-a-crown, and we cannot conceive any one purchasing the work under notice with that fact in view. We may add that we consider that those who use latin words should make themselves sure of their accuracy. We should have taken *speculæ* for an error of the printer, had it not occurred twice on the same page.

Tuttle's Comet.—This object was obseved by M. Borelly, at Marseilles, on October 12. The comet had the appearance of a diffuse nebulosity, badly defined; it appeared elongated in the direction N.W. by S.E.; it was feeble, but of moderate extent, about 2′ 20,″ m.m. Loevy and Tisserand observed it at Paris, October 14; it resembled a diffuse, irregular, whitish nebulosity, diameter about 3′; with a light about equal a star of the 31th magnitude

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CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

JUPITER.

Sir,—Now that many telescopes are being turned to this noble planet, the lithographs at the head of this number of the *Register* will, no doubt, be interesting to many of your readers. Perhaps a few remarks on the more notable features lately seen on the disc will also be acceptable.

Those who had the good fortune to see the fine ellipse, which during the winter 1869-70 lay in the bright southern zone, will not soon forget it. So far as I have been able to learn, it was seen only by Dr. Mayer, in Pennsylvania, and Mr. Crossley and myself at Halifax. I first caught sight of it in November, 1869; Dr. Mayer first saw it on the 5th of January, 1870; and it was last seen here on the 29th of March, 1870.

The planet was carefully scrutinized here in October and November of this year; but unfavourable weather prevented us from obtaining a complete set of drawings. On the 1st of December, however, the proper view was secured; and, although the motion was too great to admit of good micrometric measurements, yet a little patient watching enabled me to make a good sketch. At 11½h. p.m., No. 1 was very faint; but near its western end were two small dark spots.

No. 2 appeared much as it is usually seen.

The zone between bands 2 and 3 was very bright, in fact the only bright zone on the planet at this time.

Near the east end of No. 3 were two dark spots.

Under No. 4 were seen the festoons, but they appeared much flatter than usual. Above No. 4 and near the western edge of the disc was a very large dark spot: it was not nearly so dark as those above named, but had rather the appearance of a detached portion of a broad band. It lay upon No. 5. It was broadest where it was in contact with this band. To the east of this object lay the ellipse; within it was seen a short slightly curved dark line: a pretty dark band was in contact with the upper edge of the ellipse. A very rough measure gave 15″ as the length of the longer diameter of this curious object.

On the 4th December, at 10 p m., the new band in the zone between 2 and 3 was very finely seen: it had two small dark spots on it.

Soon after midnight this new band nearly filled up the bright zone in which it lay, for it now was seen to consist of a number of very broad detached portions nearly connecting bands 2 and 3 together. At this time No. 5 was a fine broad band, but broader in the middle; and No. 1 had a short curved dark streak upon it.

1	...	Nov. 9th	...	12.30 p.m.
2	...	Oct. 9th	...	4.30 a.m.
3	...	Nov. 9th	...	3.15 a.m.
4	...	Dec. 1st	...	11.30 p.m.
5	...	„ 4th	...	10.40 p.m.
6	...	„ 4th	...	12.30 p m.

I am, Sir, yours very truly,

JOSEPH GLEDHILL, F.G.S., &c.

Mr. E. Crossley's Obervatory,
Park Road, Halifax: Dec. 20, 1871.

VENUS.

Sir,—In the generally accurate report of the November meeting of the Royal Astronomical Society, contained in your last number, there occurs an error to which I wish to call attention, principally because it enables me to refer to a question of some interest.

In page 277, I am reported to have said, during the discussion on a paper by Captain Noble, that I had seen the disc of Venus all round at her last inferior conjunction in September 25-26. I did not observe Venus on that occasion, and what I did say was that Dr. Winnecke had then seen the whole disc of Venus. His observation is printed in the *Astronomische Nachrichten*, No. 1863, page 236, and he there states that he was endeavouring to find how far the extension of the horns of Venus could be traced about the time of conjunction. Observing the planet a little before noon on September 25, with a heliometer of 34 lines in aperture, the horns appeared to him to extend over not more than 180° in all, or about half the circumference. "But," he says, "in the moments of greatest steadiness of the image, the whole disc of Venus appeared to be visible. Although the part of the disc not illuminated by the sun appeared very faint in the gray light, yet there was scarcely a doubt in my mind of the reality of the phenomenon." The weather after that day was not sufficiently good to permit Dr. Winnecke to repeat the observation, and he hoped that other observers were more favoured in that respect. "So far," he concludes, "as I know, the observation of the culmination of Venus by Andreas Mayer, at Greifswalde, on the 20th of October, 1759, is hitherto the only one at which the secondary light of Venus has been perceived near the middle of the day."

The question seems to be interesting as to whether or how far this appearance is due to a secondary light of Venus (or a light diffused over her by a highly refractive atmosphere), or to the fact of the darker body of the planet showing its existence as it were by the effect of contrast on the greyish light of the sky as seen in the telescope. I say, "how far," because it is quite likely that both causes may be operative; but, in as far as the effect seen is due to the latter cause, one would suppose that it would be most marked in the part of the disc of Venus which is farthest from the part illuminated by the sun.

I am, Sir, yours faithfully,

Blackheath: December 13, 1871. W. T. LYNN.

ENCKE'S COMET.

Sir,—I beg to send you the result of an observation of Encke's Comet, made under peculiarly favourable atmospheric circumstances and possessing, I think, considerable interest.

Sir John Herschel in his *Outlines of Astronomy* states that "Encke's Comet has no tail." I believe that statement now requires modification.

On December 3 I observed Encke's Comet with my $8\frac{1}{2}$ inch Browning, with reflector, using a Kellner eyepiece, power of about 60 diameters, the atmosphere being beautifully clear and steady. On first viewing the Comet at a few minutes after 5 p.m., it appeared as the fan-shaped body described by other observers; but, as the twilight diminished and the background became darker, a new feature was apparent. The Comet then presented somewhat the appearance depicted in the annexed sketch. A fan-shaped head from which proceeded, in the opposite direction to the sun, a faint tail, the length of which I roughly estimated at $1\frac{1}{4}$ times the diameter of the head. The position angle of a straight line running from head to tail of the Comet was about 60°. The tail was exceedingly faint, the north side decidedly brighter and better defined than the south, the

curve bounding the head on the preceding side seemed continued down, forming the north boundary of the tail. The Comet was attentively observed till 6·20 p.m., and the sketch is a copy of one made at the telescope.

My instrument is in excellent adjustment, and everything my ingenuity could suggest was resorted to, to prove beyond doubt that the tail seen was a *bona fide* appendage to the Comet.

At the November meeting of the Royal Astronomical Society, the Astronomer Royal called attention to the fact that "the tail, if there was such an appendage to Encke's Comet, was turned towards the sun, and in right ascension went first." With the greatest deference to such high authority, I think that view can now be proved to be erroneous.

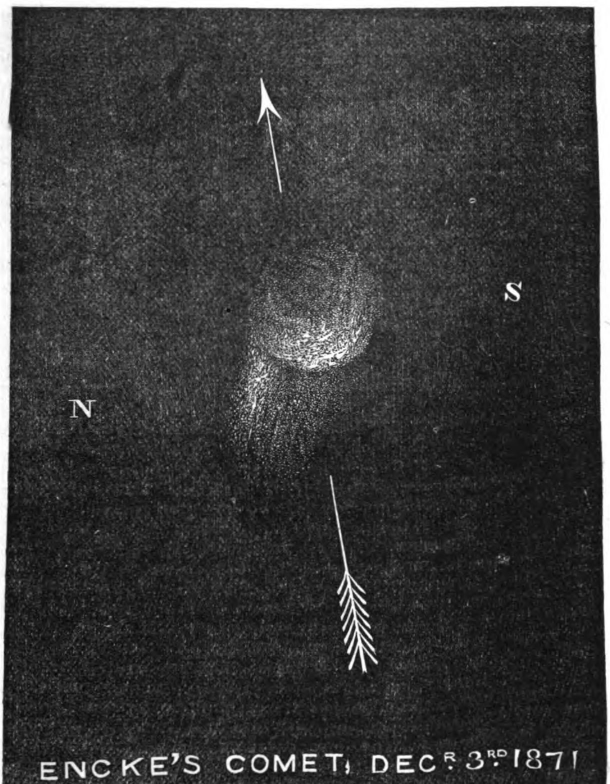
I trust other observers, with more powerful instruments, will be able to confirm my observation.

I should add that unfavourable weather had prevented any observation for a fortnight prior to December 3, and since that date I have been able to examine the Comet only through haze and fog, and clouds of steam from the breweries in this town, not obtaining a clear view of it for a single instant.

I am, Sir, your obedient servant,

E. B. KNOBEL.

63, Guild Street, Burton-on-Trent:
December 9, 1871.



SIR,—In Encke's formula for the effect of the ethereal medium on the motion of his comet, U, is the constant depending upon the resistance; will some gentleman give its numerical value in the next number of the Register?

Yours truly,
H. PETTY.

FAINT STARS AND HIGH POWERS.

SIR,—In reply to Mr. Lancaster, No. 107, page 258, I have looked through my notes with this general result, with a 2·9-inch refractor and 9-inch reflector: When the limit is about reached, the visibility is in proportion to the power the state of the atmosphere will allow. I have pretty freely used, for experimental purposes, various apertures, ranging between these limits, with similar results. It would be too long a list to give here in illustration, but I have noted exceptions to the general rule, some of which follow:—

ι Cassiop, 2·9-in. ap. 9 mag. distinctly, but best with 74 and 60.
ι Ursæ Maj., 13 mag. 6½-in. ap. 132 better than 212 or 87.
θ Orionis, 5th and 6th; 6½-in. ap. 132 better than 212.
a^2 Capric, 16 mag. 9-in. ap. 132 very much better than 212.

I am inclined to think that the two latter cases arise more from atmospheric difficulties than any peculiarities in the small stars. It will be obvious that the powers which can ordinarily be used on minute points will not be in proportion to the aperture, the unsteadiness of the focal image in large instruments being the great difficulty. This is very obtrusive generally with high powers on the brilliant Alpha Lyræ. Though a beauteous gem, its flashes are not always appreciated by him who is spying out its modest acolyte. On Polaris my experience is contrary to Mr. L.'s. I find it no exception to the general rule.

As to moonlight, it is to be remembered that our satellite is seldom nearer the Pole than 60°, and as often its distance approaches 120°. I have seen the *comes* with 1½-in. ap. reflector (=1⅝-in. refractor) and power 87, when the moon was some degrees above the horizon; and with 132 when the half moon was 90° from Polaris. Under the same circumstances the *debi lissima* in ϵ Lyræ were readily visible with a clear ap. of 3·3-in. (=3-in. refractor) and power 320; 212 showed them, but required more attention.

Doubtless, the better the *quality* of the telescope. the lower the power *required* to see a given faint star, and the higher the power the said star would bear.

I am, Sir, yours very truly,
T. H. BUFFHAM.

Bonner's Road, Victoria Park:
Nov. 13, 1871.

AURORA BOREALIS.

DEAR SIR,—On Friday evening last the Aurora Borealis was seen here to a great advantage. I noticed it first at about 7.30, when it was of a pale white colour, and it gradually increased in brilliancy till 10 p.m., when it changed to a bright crimson, and spread all over the northern quarter of the heavens. It soon, however, returned to the colour on its first appearance, and gradually disappeared towards 1.30.

I am, Sir, yours obediently,
HENRY COX.

Pembroke College, Oxford:
Nov. 13, 1871.

EPSILON LYRÆ.

Sir,—In the Astronomical Register for November there is an interesting communication from Mr. C. Grover, on that beautiful and interesting group known as Epsilon Lyræ. Having of late given considerable attention to this group, I carefully endorse the observations of Mr. Grover.

With respect to the variation of the "Debilissima' couple, I have, on several occasions noticed the change of brightness in these stars. Sometimes one and sometimes the other taking the lead in brilliancy.

In the same Reflector (8½ inch silvered glass by Browning). The three small stars preceding the "Debilissima," and forming a triangular figure, are conspicuous objects, nearly as obvious as the 9th mag. star following the "Debilissima" couple, except the one forming the southern angle. The 15th mag. star, north of the north following star of the "Debilissima," I have, on several occasions, seen, (the nights have to be very fine and bright). This addition, as Mr. Grover remarks, brings up the number of stars composing this group to eleven.—*So I see them.*

I now wish to call the attention of observers, who take an interest in this subject. to a diagram of the late Rev. W. R. Dawes; also to a letter of Mr. A. P. Holden.

In the *Register*, Vol. 2, page 301, there is a diagram from the late Mr. Dawes. Figure the 2nd contains four stars (2 pairs) preceding the "Debilissima" couple; these. with the other members in the diagram, bring up the number of stars composing this group to eleven, the same number as Mr. Grover's. But we must bear in mind the fact that the 15th mag. star, mentioned by Mr. Grover as situated north of the north following-star of the "Debilissima," is not contained in Mr. Dawes's diagram.

In the admirable letter of Mr. Holden (see *Register* of February last), which I have read with pleasure and delight, the following passage is recorded:—"To sum up the whole group as observed upon these several occasions, I think that I may safely put them in the following order of brilliancy, calling the various pairs in their order of distance from a line joining E 1 and E 2. No. 1 (the "Debilissima"), No. 2, No. 3, and No. 4. Here we have no less a number than six stars (3 pairs) preceding the "Debilissima" (two more than in Mr. Dawes's diagram), and, certainly, must bring up the number of stars composing this remarkable group to no less a sum than *thirteen*, and, from what I can see of his (Mr. Holden's) letter, there is no mention whatever of the 15th mag. star.

It would appear, from the diagram of Mr. Dawes, and more particularly from the letter of Mr. Holden, that there are stars between the "Debilissima" couple and the three small stars forming the triangular figure, which my friend Mr Grover and myself have not been able to identify. I have repeatedly looked for them, but up to the present time have not been able to ascertain any. The subject is very interesting, and I hope that other observers, with adequate means, will make a careful search for these minute stars, and communicate their observations.

Yours truly,
HENRY SQUIRE.

New Invention, near Wolverhampton:
November 11, 1871.

CUI BONO?

Sir,—If there be anything in the remarkable theory of Mr. Galton, developed in his work on *Hereditary Genius*, the conclusion seems irresistible that Mr. William Waite, of London, quoted on page 287 of your last

number, must be a lineal descendant of the late Mrs. Nickleby. Perhaps I shall best justify this assertion, and show how absolutely cognate were and are the intellectual types of this lady and gentleman referred to, if I quote in parallel columes from their published utterances:—

Mr. Waite.

"It may interest you to know that some years ago, I saw, what I suppose must have been a planetary body in transit across the sun. A dark speck in the lower limb of the sun caught my eye just about sunset; thinking it to be a sun spot, I got a glass to look at it, but found it to be a globular body of the apparent bigness of an ordinary sized marble, and intensely black. I had not time to notice in which direction it was moving, as the sun dipped almost immediately. Unfortunately, I am not able to recollect what year it was in, but it must have been between June 1860 and June 1863, and I imagine the season was either spring or autumn, as the house fronted nearly due west, and the sun was setting just opposite."

Mrs. Nickleby.

"Roast pig, let me see, on the day five weeks after you were christened, we had a roast—no that could'nt have been a pig either, because I recollect that there were a pair of them to carve, and your poor papa and I could never have thought of sitting down to two pigs—they must have been partridges. It's very odd now what can put that into my head. I recollect dining once at Mrs. Bevan's in that Broad Street, round the corner by the coachmakers, where the tipsy man fell through the cellar flap of an empty house nearly a week before quarter-day, and was'nt found till the new tenant went in—and we had roast pig there. It must be that, I think, that reminds me of it, especially as there was a little bird in the room that would keep on singing all the time of dinner—at least, not a little bird, for it was a parrot, and he did'nt sing exactly, for he talked and swore dreadfully; but I think it must be that. Indeed, I'm sure it must. Should'nt you say so, my dear?"

Seriously, though, I am entitled to ask why the pages of the *Astronomical Register* should be filled with records of such observations. I should be the first to deprecate the introduction of any mere personality into your columns; but now, at the risk of the semblance of it, I cannot refrain from saying, in the interests of a considerable section of your readers, that we are favoured with with a trifle too much of the platitudes of the self-styled Observing Astronomical Society. Might I venture to hint to the Honorary Secretary that quality rather than quantity is what is desirable in such communications as those with which he favours us.

Yours faithfully,
A SUBSCRIBER.

BERTHON'S DYNAMOMETER.

Sir,—I can fully endorse Mr. Levander's remarks, as to the capital results which may be obtained with the Rev. E. L. Berthon's Dynamometer, having given it a careful trial with a number of eyepieces, ranging in magnifying power between 60 and 791. The only point requiring a little care in using it is, the getting an even balance between the illumination of the scale and that of the disc to be measured, otherwise irradiation would render the measures difficult, and the results probably very erroneous. In my experiments I opened the top shutter of my observatory dome towards the north, getting a good direct light on

the V. scale, while light was reflected to the object-glass from a sheet of white paper on the opposite side of the observatory.

After I had made trial of the Dynamometer with an ordinary pocket lens of about 1¾-inch focus, Mr. Berthon kindly sent me an ingenious little lens-holder, or microscope, which clips on to the eye-piece of the telescope, and thus leaves both hands free for the V. gauge, adding immensely to the comfort and ease of observing. On receiving it, I repeated my measures of a battery of negative eye-pieces, the magnifying powers of which had been determined by the late Rev. W. R. Dawes, with, I believe, a double image dynamometer, and the accordance of the three series of measures is so satisfactory, that I am induced to give them here.

Dawes	89	191	258	424	605	791
Knott (1)	91	191	259	425	604	792
Knott (2)	90	192	260	424	604	798

Since my letter of October 16, I have obtained one more set of measures of δ Cygni, with these results: P. = 337°·30, D. = 1″·660, Epoch, 1871·809, Combining the whole series, we have the following mean result: P. = 337°·92, D. = 1″·690, Epoch, 1871·74.

Woodcroft Observatory, Cuckfield, Sussex: Dec. 5, 1871

I am, Sir, yours faithfully,
GEORGE KNOTT.

DYNAMETER OR DYNAMOMETER.

Dear Sir,—Your reply to the enquiry of "Query," given in the current number of the *Register* (p. 294), as to "which is the right appellation of be used in describing the little instrument for measuring the power of eye-pieces," is by no means satisfactory to me. As far as I have been able to ascertain from the authorities which I have at hand, I venture to say that both words are in use, and that both are derived from δυναμις and μετρεω, that they indicate entirely different instruments, and that "the right way of spelling the word" is in fact beside the question.

Dr. Kitchiner in his work "Of Telescopes," p. 238, writes, that "to measure the diameter of the pencil of rays with great ease and accuracy, Mr. Ramsden, about the year 1775, contrived a clever little instrument which he called a *dynameter*." Admiral Smyth says ("Celestial Cycle," I. 382), "various methods of determining the magnifying power of a telescope have been proposed, but Ramsden's double-image *dynameter* has been successfully adopted," and quotes from Dr. Pearson's "full and able" description of the instrument. Mr. Simms also says ("Achromatic Telescope," p. 22). "the *dynameter* is the instrument employed in measuring the image of the object-glass upon the eye-glass."

In the "Encyclopædia Britannica" (7th edition), the *dynameter* is stated (vol. viii. 388) to be an instrument for ascertaining the relative strength of men and animals, and that it resembles a common graphometer, the whole machine weighing only two pounds and a half! Further (vol. ii. 267), "several inventions are said to be in use for ascertaining and comparing the power required to work the plough in different situations; these are known by the name of *dynamometers*, or draught machines, and they all agree in this that the power is determined by a movable index, pointing to figures denoting hundredweights on a dial-plate." Again, (vol. xx. 681) "the *dynamometer* which is generally employed to measure the force of steam in a boiler is a simple tube," &c.

Moreover, in Ogilvie's "The Comprehensive English Dictionary" (Blackie & Sons, 1864), both words thus appear—"DYNAMETER (Gr., δυναμις and μετρεω), an instrument for determining the magnifying power

of telescopes. DYNAMOMETER, an instrument for measuring force, especially the relative strength of men and animals (see Dynameter)."

The above extracts conclusively show, as I submit, that both words are correct, that they purposely differ orthographically, to prevent confusion and ambiguity in describing scientific instruments, and that *dynameter* and not *dynamometer* is the proper designation for an instrument to determine the magnifying power of a telescope. If I am wrong in my conclusions, I hope one of your many able correspondents will set me right in the matter.

Yours faithfully,

Upper Holloway: Dec. 11. GEO. WILLIAMS.

[The word dynameter means nothing at all, and so it is a pity some better word, if necessary, has not been coined. If the word be used at all, the form dynamometer is the only admissible one. You might as well, if another instrument for measuring time were required than the chronometer call it a chrometer. It may also be well to notice that in all such words, the derivation is *not* from *μετρέω* but *μετρον*. The Greeks never compounded verbs with anything but prepositions.—EDITOR.]

FUTURE ECLIPSES.

All your correspondents must have been gratified by your publication of Mr. Hind's calculations respecting future Solar Eclipses, both those in the September number, commencing with that of 1905, and also those for the next twenty years, published in the November number. Let me inform Mr. Hind that he has omitted one fine eclipse, that of May 28, 1900. A computation I have made shows that three-fourths of the Sun's disk are obscured at London that afternoon. In Guillemins' "Heavens," the central path is stated to cross Spain, Algeria, Egypt, and the United States, but one would like to know more particularly. CURIOSUS.

B. A. C. 5554.

Sir,—In the British Association's Catalogue of Stars, and in the compilations from it in Loomis's "Practical Astronomy," and Mr. Proctor's "Handbook of the Stars," the fourth magnitude is assigned to B. A. C. 5554, a star in the southern constellation Ara, now of the sixth magnitude—position for 1850, R.A. 16h. 29m. 42s., S. Dec. 60° 37′ 16″. I am not aware that this discrepancy has ever been corrected. A mistake seems to have arisen in copying from Brisbane's Parramatta Catalogue, where the star in question is marked 7th mag., on the faith of one observation only. This to the Astronomer of N.S.W., Mr. H. C. Russell (who examined the star at my request) appears to have been slightly underrated, as he makes the present magnitude of B. A. C. 5554 equal to the sixth.

Being very much interested with the account given by the late Admiral Smyth, in his charming "Sidereal Chromatics," of the change in colour of 95 Herculis, I watched this star very attentively during the months of July, August, and September this year, with my telescope, an achromatic of 4-ft. focal length, 3-in. clear aperture, and good definition. 95 Herculis attains a meridian altitude at Sydney of 34½°. To me the components of this pair always appear of a fine bright golden yellow, without any trace of the red or green seen by other observers. Several friends to whom the object was shown, all concurred in naming the colours "yellow," or "golden yellow." Have any recent changes been recorded in England?

I have only lately obtained a copy of Sir J. Herschel's invaluable "Cape Observations," and find that a large proportion of the double and multiple stars contained in that work, can be readily seen with a good

3-in. telescope. Mr. Webb, in his most useful "Celestial Objects," gives a catalogue of southern doubles, but I have already picked out from the "Cape Observations" several (about 80) pairs not included by him, and no doubt shall find others as the season advances. As I do not own a micrometer, only one instance of change in position has been noticed since Sir J. Herschel's time (1834-8), viz, θ Indi, R.A. 21h. 10m., Dec. S. 54°, distance 4″, mags. 5 and 10, a very beautiful double and a fine light-test for small telescopes, mine shows it distinctly. Sir J. Herschel found the position angle measured 307°, not being able to reconcile this with a rough measurement taken by means of a wire inserted in the eye-piece, I asked Mr. Russell to measure the pair accurately for me. This he very kindly did, and finds the position angle to be 292°, thereby establishing a change of position of 15° in about 30 years.

326, George Street, Sydney, N.S.W.: Oct. 6, 1871.

I remain, yours obediently,
W. J. MACDONNELL.

JUPITER.

G. M. T.		Zenographical longitude of the centre of ♃'s disc. 8h.	10h.	12h.	14h.	16h.		Angle of pos. of ♃'s axis. 12h.
1872.		°	°	°	°	°		°
Jan. 0	...	215	287	0	73	145	...	12·77
1	...	6	78	151	223	296	...	·72
2	...	157	229	302	14	87	...	·67
3	...	307	20	93	165	238	...	·62
4	...	98	171	243	316	29	...	·57
5	...	249	322	34	107	179	...	·52
6	...	40	112	185	258	330	...	·47
—								
7	...	191	264	336	49	121	...	12·41
8	...	342	54	127	200	272	...	·36
9	...	133	205	278	350	63	...	·31
10	...	284	356	69	141	214	...	·25
11	...	74	147	220	292	5	...	·20
12	...	225	298	10	83	156	...	·14
13	...	16	89	161	234	306	...	·09
—								
14	...	167	240	312	176	97	...	12·03
15	...	318	30	103	176	248	...	11·98
16	...	109	181	254	326	39	...	·92
17	...	259	332	45	117	190	...	·87
18	...	50	123	195	268	341	...	·82
19	...	201	274	346	59	131	...	76
20	...	352	65	137	210	282	...	·71
—								
21	...	143	215	288	1	73	...	11·65
22	...	294	7	80	152	224	...	·60
23	...	85	158	231	303	15	...	·54
24	...	235	308	22	94	166	...	·49
25	...	26	99	171	244	316	...	·44
26	...	177	250	322	35	107	...	·38
27	...	328	40	113	186	258	...	·33
—								
28	...	119	191	264	336	49	...	11·28
29	...	270	342	55	127	200	...	·23
30	...	60	133	205	278	350	...	·18
31	...	211	284	356	69	141	...	11·13

Zenographic latitude 1° North.

SUN.

Greenwich, Noon. 1872.		Heliographical longitude of the apparent centre			Heliographical latitude of the sun's disc.		Angle of position of the sun's axis.
		°			°		°
Jan. 1	...	259·74		...	—3·23	...	2·00
2	...	272·93		...	3·34	...	1·51
3	..	286·11		...	3·46	...	1·02
4	...	299·30		...	3·57	...	0·53
5	...	312·48		...	3·68	...	0·04
6	...	325·66		...	3·79	...	359·55
7	...	338·85		...	—3·90	...	359.07
8	...	352·03		...	4.01	...	358·58
9	...	5·22		...	4·11	...	358·10
10	...	18·40		...	4·21	...	357·61
11	...	31·58	$+10\ \delta\xi$	...	4·32	...	357·13
12	...	44·76		...	4·43	...	356·65
13	...	57·95		...	4·53	...	356·17
14	...	71·13		...	—4·63	...	355·69
15	...	84·31		...	4·73	...	355·22
16	...	97·50		...	4·82	...	354·75
17	...	110·68		...	4·92	...	354·28
18	...	123·86		...	5·01	...	353·82
19	...	137·04		...	5·10	...	353·35
20	...	150·23		...	5·19	...	352·89
21	...	163·41	$+20\ \delta\xi$	...	—5·28	...	352·43
22	...	176·59		...	5·37	...	351·98
23	...	189·77		...	5·46	...	351·53
24	...	202·96		...	5·54	...	351·09
25	...	216·14		...	5·62	...	350·64
26	...	229·32		...	5·70	...	350·21
27	...	242·50		...	5·78	...	349·77
28	...	255·68		...	—5·86	...	349·34
29	...	268·87		...	5·93	...	348·91
30	...	282·05		...	6·01	...	348·49
31	...	295·23	$+30\ \delta\xi$	...	—6·08	...	348·07

Assumed daily rate of rotation, 14·2° + $\delta\xi$.

MINIMA OF ALGOL.

According to Prof. Schoenfeld.

				h.
1872.	Jan. 6	...	15·6	G. M. T.
	9	...	12·4	
	12	...	9·2	
	15	...	6·0	
	26	...	17·3	
	29	...	14·1	
	Feb. 1	...	11·0	

MINIMA OF S. CANCRI.

Jan. 1	...	12·0h.
20	...	11·2

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, Midnight			60°N.		0°		60° S.
				Sunset.			
			°		°		°
1872. Jan.	1	...	+15·0	...	+15·9	...	+16·8
	2	...	+ 2·8	...	+ 3·7	...	+ 4·7
	3	...	− 9·4	...	− 8·4	...	− 7·4
	4	...	21·6	...	20·6	...	19·5
	5	...	33·8	...	32·7	...	31·6
	6	...	46·1	...	44·9	...	43·8
	—						
	7	...	−58·3	...	−57·1	...	−55·9
				Sunrise.			
	13	...	+51·2	...	+49·8	...	+48·3
	—						
	14	—	39·1	...	37·6	...	36·1
	15	...	27·0	...	25·4	...	23·9
	16	...	14·8	...	13·3	...	+11·7
	17	...	+2·7	...	+ 1·1	...	− 0·5
	18	...	−9·4	...	−11·1	...	−12·2
	19	...	21·5	...	23·2	...	24·9
	20	...	33·6	...	35·4	...	37·1
	—						
	21	...	45·7	...	47·5	...	49·3
	22	...	57·8	...	59·6	...	61·4
	23	...	69·9	...	71·8	...	73·6
	24	...	−82·0	...	−83·9	...	−85·8
				Sunset.			
	26	...	+69·9	...	+71·8	...	+73·8
	27	...	57·7	...	59·7	...	61·7
	—						
	28	...	45·6	...	47·6	...	49·6
	29	...	33·4	...	35·4	...	37·5
	30	...	21·2	...	23·3	...	25·4
	31	...	+ 9·0	...	+11·1	...	+13·3

The sun's disc passes the zone horizon of Linné—
On Jan. 1 from 19·4 to 20·6 setting.
16 „ 15·7 „ 16·9 rising.
31 „ 9·3 „ 10·5 setting.

THE PLANETS FOR JANUARY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	{ 18 51 36 / 18 45 48 }	— { 20 26 / 20 18½ }	10″·0	0 9·7
	15th	18 13 30	—20 56	7″·8	22 32·8
Venus ...	1st	15 38 47	—16 38½	19″·0	20 53·5
	15th	16 45 37	19 57	17″·0	21 5·1
Jupiter ...	1st	7 55 9	+21 14	43″·2	13 11·2
	15th	7 47 25	21 36½	43″·4	12 8·4
Uranus ...	1st	8 9 14	+20 44	4″·2	13 25·2
	17th	8 6 24	20 53	4″·2	12 19·5
Neptune ...	1st	1 21 11	6 42½	0″·2	6 38·3
	17th	1 21 26	6 45	1″·3	5 35·6

Mercury rises a little before sunrise at the beginning of the month, the interval increasing till the middle of the month, after which it decreases.

Venus is excellently situated for observation, passing the meridian at about 9 o'clock in the morning during the month, and so a very favourable object for transit observations during the daytime.

Jupiter may be observed throughout the night, and should be carefully examined by those who have powerful instruments, as all reliable observations of change of colour or markings will be valuable.

Uranus is, like Jupiter, very favourably situated for observation.

LUNAR METEOROLOGY.

By W. R. Birt, F.R.A.S.

Under this title we propose occasionally to give notices of such phenomena as may be difficult to account for on variations of the angle of illumination, or may be referred to the action of heat upon the surface of the moon, for as all meterological processes on the earth depend more or less upon the action of heat, so if we are able to detect evidence of the same action on the moon, we may, without employing the term improperly, regard the phenomena observed as partaking of a meteorological character. Change of colour, we know, to be intimately connected with thermal relations, the early spring tints of vegetation, the dark foliage of summer, the rich hues of autumn, alike bespeak the effects of solar heat upon the vegetable covering of the earth. Not that we wish to draw any

analogy between colours on the earth and moon, or even to hint in the slightest degree that a lunar vegetation exists, but to direct attention to the fact that, while colour characterises the moon's surface, it is not exempt from changes that can be traced immediately to the action of the sun.

Hitherto, whatever changes of colour or brightness may have been suspected, they have been unhesitatingly referred to changes either of illuminating or visual angles; very few, if any, attempts have been made to *prove* a connection between them and solar influence. The surfaces of the Maria, it is well-known, vary in tint at different periods of the lunar solar day, but whether the *same* tint characterises the *same* surface at the *same* time of day is uncertain. So far as we are aware, only one series of observations exists which bears on this point, it is of the tint of the floor of the walled plain Plato during a period of *two* years. It has long been supposed that, as the sun attains his meridian altitude, the floor becomes darker. This supposition has by the observations been exchanged for certainty, for although the method adopted was one of "estimation," a numerical value has been applied to each estimate of tint, varying from light = 0·33, through medium = 0·50, to dark = 0·66. On projecting the results of the observations for intervals of 12 hours from sunrise to sunset on Plato, the range of tint is found to be equal to 0·41, while that of the sun's altitude is about 40 degrees, the chromatic curve agreeing essentially with that of altitude.

Upon what does this *darkening* depend? Is it on the angle in which the light is reflected to us, or does it not rather depend upon the material of the floor being heated by the sun's rays. During a day of 354 hours duration, we may expect that a large amount of heat will be developed, and as we find on the earth the diurnal march of temperature is proportional to that of the sun's altitude, so we may expect that the diurnal march of lunar temperature will follow the same law, and manifest itself in the gradation of that which is now known in one instance to accompany the sun in his progress through the heavens, thus partaking of the nature of a meteorological process.

At present we have but one solitary instance, and it is very desirable that others should be added. There are numerous dark spots as well as medium and light scattered over the moon's disc. Will they all tell the same tale? It is pretty certain that the surface consists of a variety of material. Is it likely that by multiplying observations we may be able to detect a residual meteorological action, a more or less permanent darkening of certain spots, or of the fading of others. The enquiry is an interesting one, for by it we exchange vagueness for certainty, we obtain an insight into operations which may still be in progress. We know that, as on the earth, igneous action is extensively manifested on the moon, and it is difficult to conceive that when this was in full operation it was unaccompanied by meteorological phenomena. With the cessation of the one, the other may have become greatly subdued, but there is still room for solar action, and we believe that the late researches tend to establish the fact that the surface of the moon is in no small degree acted on by the sun.

In our next paper, we propose to adduce simultaneous instances of clearness and obscurity of neighbouring portions of the moon's surface, which may possibly be connected with solar heat, for it is by no means infrequent that a given area may be seen with great clearness, while an adjoining one is misty and indistinct. The earth view is synchronous, while the areas varying in definition are differences exposed to the sun's rays.

ASTRONOMICAL OCCURRENCES FOR JAN., 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Jupiter.
Mon	1		Sidereal Time at Mean Noon, 18h. 41m. 49·75s.	1st Oc. R.	7 54	—
		16 35	Inferior Conjunction of Mercury	2nd Sh. I.	11 23	13 11·2
		19 29	Occultation of ν Virginis ($4\frac{1}{2}$)	2nd Tr. I.	12 4	
		20 31	Reappearance of ditto	2nd Sh. E.	14 18	
				2nd Tr. E.	14 59	
Tues	2	18 33	Conjunction of Saturn and Sun			13 6·7
Wed	3	9 58	☾ Moon's Last Quarter	2nd Ec. D.	6 29 16	13 2·2
			Sun's Meridian Passage, 4m. 33·56s. after Mean Noon	2nd Oc. R.	9 59	
Thur	4	9 10	Conjunction of Mars and ι Capricorni (3·0m.) E.	1st Ec. D.	18 13 33	12 57·8
		16 11	Occultation of 94 Virginis (6)			
		16 58	Reappearance of ditto			
		16 43	Occultation of 95 Virginis (6)			
		17 48	Reappearance of ditto			
Fri	5			3rd Sh. I.	14 39	12 53·3
				1st Sh. I.	15 31	
				3rd Tr. I.	15 36	
				1st Tr I.	15 46	
				1st Sh. E.	17 50	
				1st Tr. E.	18 5	
				3rd Sh. E.	18 6	
				3rd Tr. E.	19 6	
Sat	6	23 22	Conjunction of Moon and Venus, 0° 57′ N.	1st Ec. D.	12 42 4	12 48·8
		21 5	Occultation of β^1 Scorpii (2)	1st Oc. R.	15 12	
		22 7	Reappearance of ditto			
Sun	7			1st Sh. I.	10 0	12 44·3
				1st Tr.. I.	10 11	
				1st Sh. E.	12 19	
				1st Tr. E.	12 31	
				4th Ec. D.	17 39 9	
				4th Ec. R.	23 30	
Mon	8			1st Ec. D.	7 10 33	12 39·8
				1st Oc. R.	9 38	
				2nd Sh. I.	13 58	
				2nd Tr. I.	14 17	
				2nd Sh. E.	16 52	
				2nd Tr. E,	17 12	
Tues	9	0 57	Conjunction of Moon and Mercury, 4° 20′ N.	1st Sh. E.	6 48	12 35·4
		16 5	Conjunction of Moon and Saturn, 2° 19′ N.	1st Tr. E.	6 56	
				3rd Oc. R.	8 45	

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Wed	10	2 57	● New Moon	2nd Ec. D. 2nd Oc. R.	9 5 38 12 13	Jupiter. 12 30·9
Thur	11					12 26·4
Fri	12	3 28	Conjunction of Moon and Mars, 3° 34′ N.	2nd Sh. E. 2nd Tr. E. 1st Sh. I. 1st Tr. I. 3rd Sh I. 3rd Tr. I.	6 10 6 19 17 25 17 29 18 38 18 51	12 21·9
Sat	13	7 11 7 50	Near approach of τ^1 Aquarii (6) Occultation of τ^2 Aquarii (4)	1st Oc. D. 1st Oc. R.	14 36 16 55	12 17·4
Sun	14			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	11 54 11 55 14 13 14 14	12 12·9
Mon	15	3 43	Opposition of Jupiter Illuminated portion of disc of Venus=0·676 „ Mars=0·970	1st Oc. D. 1st Oc. R. 2nd Tr. I. 2nd Sh. I.	9 2 11 21 16 30 16 33	12 8·4
Tues	16		Sidereal Time at Mean Noon, 19h. 40m. 58·11s. Sun's Meridian Passage 9m. 54·43s. after Mean Noon.	4th Tr. E. 4th Sh. E. 1st Tr. I. 1st Sh. I. 3rd Oc. D. 1st Tr. E. 1st Sh. E. 3rd Ec. R.	5 41 5 51 6 21 6 22 8 29 8 40 8 42 12 1 47	Moon. — 5 27·5
Wed	17	0 2 10 33 11 27 11 36 12 32	☾ Moon's First Quarter Occultation af 64 Ceti (6) Reappearance of ditto Occultation of ξ^1 Ceti ($4\frac{1}{2}$) Reappearance of ditto Saturn's Ring: Major Axis=34·11″ Minor Axis=14·25″	1st Ec. R. 2nd Oc. D. 2nd Ec. R.	5 47 47 11 32 14 32 40	6 11·4
Thur	18					6 55·2
Fri	19	10 11 5 52 7 11 14 48	Opposition of Uranus Occultation of B. A. C. 1119 (6) Reappearance of ditto Near approach of B. A. C. 1206 (6)	2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	5 37 5 51 8 32 8 45	7 39·7
Sat	20			1st Oc. D. 1st Ec. R.	16 19 18 44 58	8 25·5

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
						Moon.
Sun	21	11 6 6 39	Conjunction of Venus and ξ Ophiuchi 0° 6′ S. Near approach of *n* Tauri (6)	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	13 38 13 48 15 58 16 8	9 13·0
Mon	22	5 33 4 12 5 10	Conjunction of Venus and ξ Ophiuchi (3·9m.) W. Occultation of 2 Geminorum Reappearance of ditto ($6\frac{1}{2}$)	1st Oc. D. 1st Ec. R.	10 45 13 13 32	10 1·9
Tues	23	6 7 6 48 11 52 13 8	Occultation of ω Geminorum Reappearance of ditto Occultation of 48 Geminorum (6) Reappearance of ditto	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E. 3rd Oc. D. 3rd Ec. R.	8 4 8 17 10 24 10 36 11 44 16 1 9	10 51·7
Wed	24	5 29 15 55 13 38	Conjunction of Moon and Jupiter, 2° 36′ S. Conjunction of Moon and Uranus, 2° 44′ S. Near approach of μ^1 Cancri (6)	1st Ec. R. 4th Oc. D. 2nd Oc. D. 4th Ec. R. 2nd Ec. R.	7 42 10 9 20 13 47 15 42 51 17 8 59	11 41·6
Thur	25	5 14 4 50 5 32	○ Full Moon Occultation of γ Cancri ($4\frac{1}{2}$) Reappearance of ditto			12 30·5
Fri	26			2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	7 51 8 26 10 46 11 21	13 18·1
						Jupiter.
Sat	27	7 58 8 59 9 48 10 51	Occultation of B. A. C. 3579 (6) Reappearance of ditto Occultation of *i* Leonis (6) Reappearance of ditto	3rd Sh. E. 1st Oc. D.	6 6 18 3	11 14·6
Sun	28			2nd Ec. R. 1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	6 27 23 15 23 15 43 17 42 18 2	11 10·1
Mon	29	10 56 13 27	Conjunction of Saturn and Mercury, 0° 6′ S. Near approach of B.A.C. 4104 ($6\frac{1}{2}$)	1st Oc. D. 1st Ec. R.	12 29 15 8 2	11 5·7
Tues	30			1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E. 3rd Oc. D. 3rd Ec. R.	9 49 10 12 12 8 12 31 15 1 20 0 46	11 1·2
Wed	31	19 5	Near approach of B.A.C. 4647 (6)	1st Oc. D. 1st Ec. R. 2nd Oc. D.	6 55 9 36 42 16 2	10 56·8

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JANUARY, 1872.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight.		Objects to be observed.
	° ′		
13 ...	133 19·5	...	Hooke, Mercurius, Maclaurin.
14 ...	120 21·7	...	Mare Fœcunditatis, Palus Somnii.
15 ...	107 53·3	...	Lacus Somniorum, Daniell, Grove (*a*),
16 ...	95 52·2	...	Christian Mayer, Büshing, Buch.
17 ...	84 15·3	...	Epigenes, Scoresby, Calippus.
18* ...	72 58·1	..	Menelaus, Manilius, Mt. Hœmus.
19 ...	61 55·8	...	Timocharis, Orontius, Mösting.
20 ...	51 3·4	...	Davy, Lalande, Lassell (*b*).
21 ...	40 16·5	...	Euler, Caroline Herschel (*c*), Brayley (*d*).
22 ...	20 31·0	...	Philolaus, Foucault (*e*), Heraclides.
23 ...	18 43·7	...	Casatus, Klaproth, Riccioli.
24 ...	7 52·0	...	Dörfel Mountains, Vasco de Gama.

For additional objects consult the lists for September and November.

* On November 20. 1871, some peculiar phenomena were observed on Plato at sunrise. It will be desirable carefully to examine the floor this evening.

(*a*) On the Lacus Somniorum, between Posidonius and Hercules, are two conspicuous craters, C and D of B and M. It is proposed to designate the nearest to Posidonius Daniell, in commemoration of the chemist and meteorologist, and the northern crater, midway between it and Hercules, Grove, to commemorate the labours of the author of the *Correlation of Physical Forces.*

(*b*) Between Straight Wall and Davy, named after the President of the Royal Astronomical Society. It is suspected of having undergone a change of colour.

(*c*) Between Lambert and Mairan is a crater easily found, a ridge extending between it and Lambert. It has been named Caroline Herschel, in commemoration of that lady's astronomical labours.

(*d*) In a line with Lambert and Euler is a crater about the same size as "Caroline Herschel," with two smaller ones, E. and W. of it. This has been named in commemoration of the scientific labours of the late E. W. Brayley.

(*e*) Between Bianchini and Harpalus, a little removed on the south from a line joining them, is a crater named Foucault.

During the late winter and spring months, the early moon is well situated for observing objects near the west limb, especially as libration is carrying them east of their mean places in January. The following objects, arranged from north to south, may be noticed between new moon and the 13th, they are all near the limb:

Gauss, Seneca, Plutarch, Neper, Mare Smythii, Käshrer, Ansgarius, Behaim, Hecatœus, Wilhelm, Humboldt, Marinus, Oken, Hanno, Pontécoulant.

Errata.

November, note (*a*) for *marked* read *named.*
December 15, for *Trallis* read *Tralles.* 24, for *Remer* read *Reiner.*

Aerolite.—A few days ago an aerolite, weighing 127lb., is said to have fallen in the grounds of M. Lepescheur, near Montereau, Seine-et-Marne. It arrived from the east, and burst over the garden with a noise similar to that of a fire of musketry, in the midst of a bright blue light. This bolid, which is of an irregnlar spheroid shape, and black, will be sent to the Academy of Sciences.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.

Cooke, T. E.
Elliot, R.
Elvins, A.
Jones, Rev. T.
Landell, W. W.
Loewy, B.
Ormisher, H.
Petty, T.
Yeates, Miss
Yeates & Son, Messrs.

To Feb., 1872.

Linwood, Rev. W.

To March, 1872.

Finch, A.
Heelis, J.
Surgeon M. Hendry

To April, 1872.

Williams, Prof. Moriere.

To May, 1872.

Hervey, Rev. G.

To June, 1872.

Buffham, T. H.
Glover, E.
Squire, H.

To Dec. 1872.

Baldelli. Comptesse
Baxendell, J.
Gaudibert, Rev. C.
Gilby, J.
Hall, Rev. R.
Johnson, Rev. S. J.
Jones, Rev. E.
Joynson, J.
Kershaw, A. E.
Lee, J.
Loddiges, C.
Smelt, Rev. M.A.
Smyth. Prof. Piazzi
Stanistrert, J. F.
Tidmarsh, Rev. T. B.
Walker, G. J.

Book received.—Report of the Royal Observatory, Edinburgh, July 27, 1871.

TO CORRESPONDENTS.

The Greenwich picture of Encke's Comet is unavoidably postponed.

It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

APPENDIX.

REPORT OF THE OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS MADE BY THE MEMBERS.

Solar Phenomena.—Mr. T. G. E. Elger, F.R.A.S., reports that "on August 19 many large scattered groups of spots were observed. The most remarkable of them measured, at 3h., about 2′ 56″ in extreme length: the penumbra, which was very irregular in shape, contained upwards of one hundred small black spots. During the month of September no large groups were remarked. On the 7th the sun was quite free from spots, with the exception of four small punctures without penumbræ; and on the 18th the large groups of August 19 had diminished to such an extent that they were scarcely deserving of notice. The portion of the sun's disc which had been occupied by the large spot of August 19 was near the W. limb on September 17, and was observed to be of an intensely brown colour; this appearance was frequently remarked in connection with the large groups of last year." Mr. T. W. Backhouse writes:—"My only September observation of the sun worth mentioning is that, on the 20th, when there was a largish spot on the middle of the S. zone, its umbra was of a singular shape; at 3h. 10m. it was 23,000 miles long, but half the length consisted of a very narrow, straight projection, and it was 9,500 miles wide. Its penumbra was only 29,000 miles long.

Meteors.—On September 10, 7h. 4m., "while daylight was too strong for the visibility of any stars," the Rev. S. J. Johnson, of Crediton, witnessed the appearance of a meteor of considerable brightness. He says, "It started about 25° above the S. horizon, and after taking a diagonal course ended at an altitude of about 10°. It continued in sight about 5 seconds." The meteors of August were well observed by Mr. E. Neison, of London, who, with the assistance of two friends, obtained the following results:—

METEORS SEEN.

Date.	Time of Obs.	Duration of Obs. m.	Very bright.	Bright.	Total.	Number per hour.
Aug. 6	9.50 to 10.47	49	2	4	15	18
7	8.58 to 10.35	97	4	13	43	27
8	9.45 to 10.18	33	2	9	29	53
9	9.5 to 10.21	86	5	16	62	43
10	10.7 to 10.58	51	4	27	90	106
11	Cloudy, clear for a brief interval.	5	1	—	2	24
12	9.55 to 10.26	31	3	7	20	39
13	9.0 to 9.56	56	2	8	25	27
	Total ...	6h. 48m.	23	84	286	Avg. 42

Mr. Neison remarks that the total observable meteors were without doubt over 500, as only about one-half of the sky was kept under view.

Cotham Park, Bristol: WILLIAM F. DENNING,
November 7, 1871. Hon. Sec.

Aurora Borealis.—On the evening of November 9, Mr. William F. Denning observed a very interesting, though not very grand, exhibition of the Aurora Borealis. He first noticed the phenomenon at 7h. 30m., when there was a large arch of auroral light extending from places about 45° east and 45° west of the northern horizon, and passing just below Beta Aurigœ, through Ursa Minor, over the star Gamma, and on through the head of Hydra, enveloping the stars Beta and Gamma in that constellation. The light was most intense in the N.W. and N.E. Many changes were apparent in the intensity of this arch, and it soon appeared to be broken, and gradually became fainter, until at 7h. 57m. all traces of it were gone. I noticed no streamers at all, but at the time when the phenomenon was at its best, an intense glow was suffused over the northern horizon. Much later in the evening, and indeed throughout the greater portion of the night, this glow was still apparent through breaks in the stratus clouds that were situated in proximity to the northern part of the horizon.

The Nebula in the Pleiades in Taurus.—Mr. Albert S. Holden reports that "with good eyesight and a clear atmosphere I have failed to find the slightest traces of the nebula on all occasions; I have, therefore, no hesitation in saying that in instruments of 3-in. aperture and under this object is utterly invisible. I beg some members of the Society to search for this object with larger instruments, so that the question as to its actual disappearance may be beyond dispute. It is important that this question should be set at rest at once, because in the event of the nebula brightening we should certainly regret not having decisively established the fact of its disappearance." There are several well authenticated instances of change noticed in regard to some of the nebulæ, and it is very advisable the object spoken of above should be very carefully looked for by those who possess telescopes of greater power than Mr. Holden.

HACKNEY SCIENTIFIC ASSOCIATION.—At the First Ordinary Meeting of the Fifth Session, held on November 14, a large audience assembled to hear a paper by the distinguished selenographer, Mr. W. R. Birt, F.R.A.S., V.P. of the Association, "On the Progress of Selenography during the last Half Century."

Mr. Birt, taking as his starting point the year 1821, remarked that previous to that epoch few observers had devoted much attention to the description of detail of the moon's surface. We have, he said, some good drawings of Bianchini, aud a valuable series by Schröter, which, with the letterpress of his "Selenotopographische Fragmente," constitute an important store of facts for continual reference. It was about the commencement of the last half century that Lohrmann took up selenographical work, and produced in the year 1824 four of his sections on a connected scale, which in this respect differs materially from Schröter's plan. He also introduced what may be termed the "German style," by attempting to depict hypsometrical and chromatic relations by a species of contouring and shading. Perhaps in the latter he has been the most successful, because in the absence of anything like a *datum level* on the moon, and the large scale that is necessary for delineating relative contours, an attempt to depict relative heights must be unsatisfactory. Nevertheless, his sections contain most valuable information, and have certainly con-

tributed to the advancement of our knowledge. The great feature of the half century is, undoubtedly, the production of the large German Map, a monument of the skill and industry of its authors, Beer and Mädler. The accurate determination of points of the first order, the approximate position of points of the second order, the accompanying letterpress "Der Mond," containing an admirable introduction to selenography, with records of observations, measurements, and formulæ, render it desirable that its perusal and study should not be restricted to German scholars, but that it should appear in an English dress. So small a portion of the attention of physicists had previously been devoted to lunar subjects, that the great work of Beer and Mädler was considered as well nigh exhaustive; in fact, there was at that time scarcely an astronomer who could or would have immediately followed up, with the energy and perseverance of the authors, a work but little understood, if we except the present Director of the Observatory at Athens, Julius Schmidt. The consequence has been a retardation of progress; for we find nothing of any moment published as illustrative of selonography between the years 1836 and 1852, when the British Association appointed a Committee for obtaining drawings of conspicuous objects, with a view to determine the effects of light upon the appearances as seen at morning, midday, and evening; and also to ascertain the relations existing between the ejected matter of the so-called craters and surrounding ramparts, supposing them to have been produced by falling ejected matter from the central orifice. In connection with this Committee three views of the Mare Crisium were published by Professor C. Piazzi Smyth, and drawings made of the walled plains Plato and Gassendi, by Professors Challis and Philip.

In the year 1856 Julius Schmidt published his "Der Mond," an interesting and useful work, containing comparisons between terrestrial and lunar forms, with sections, and other important information. This work is not much known in this country, and Mr. Birt remarked, in passing, that the small share in selenographical discovery which had fallen to English astronomers, may be attributed to the paucity of works on the physical features of the moon's surface, in the English language. Had a digest, in English, of the principal German works appeared, no doubt attention to a much greater degree would have been given to the moon. Three years later than the publication of Schmidt's work, the Rev. T. W. Webb's "Celestial Objects for Common Telescopes" appeared, and there can be little doubt that this unpretending volume has contributed in no small degree to create an interest in lunar studies; containing as it does an excellent index map, a catalogue of named objects, and several most interesting notices of the larger formations. An immediate consequence of this portion of Mr. Webb's work was the contrivance of a method by which every object on the moon's surface may be permanently registered; and in the year 1863 a register of lunar objects was commenced. In order to carry out the plan more extensively, a Committee was appointed in the year 1864 by the British Association to superintend the registration, and to map on a large scale the objects observed in its progress. This Committee has mapped three areas of 25 square degrees each, and a fourth has since been issued by private subscription. In addition, two monograms have been issued; one of the *Mare Serenitatis*, the other of Hipparchus. The number of objects at present registered is about 2,000, and nearly 500 are named up to the period of the commencement of this work; the study of the moon treated more as a whole, but it is now beginning to be understood that for real progress the separate study of selected portions is necessary, and amateurs

are steadily at work—some in studying the larger craters, others the minute objects, clefts, etc.; and others are engaged in adding to the objects already registered. Should the mode of registration be generally adopted, it will add greatly to the precision of our knowledge of the moon's surface.

The paper closed with a reference to the author's discussion of the observations of Plato, as illustrative of the advantages to be derived from the careful study of a single object, not only as to a knowledge of its principal features, but also of those agencies which have contributed to mould and modify those features; and in expressing a hope that we are now on the eve of becoming acquainted with changes in those features that are evidences of still existing activity, either of a volcanic or meteorological character, or possibly of both.

The paper was listened to with marked interest and attention; and at its close a cordial vote of thanks was moved to the eminent lecturer.

APPENDIX.

ON THE PRIMEVAL SYMBOLISM OF THE PLEIADES SIRIUS, AND ARGO NAVIS.

By G. J. WALKER.

(Reprinted from *Rathmines School Magazine*, October, 1872.)

I. The Pleiades. Atlas, who was of both heavenly and earthly extraction, according to Homer (Od. I. 52) was celebrated for his wisdom, and acquainted with the depths of the sea. He holds or keeps 'the lofty columns which keep heaven and earth asunder.' (Compare Job xxvi. 11). His name appears to signify the enduring or suffering one (*a*, euphonic). By Pleione (a name indicative of multitude), a daughter of Oceanus, he was father of the Pleiades, who according to one account were virgins,* who were changed into doves, Peleiades, and placed among the stars. The asterism, as is well known, was also utilized by the Greeks for a purpose to which the name readily lent itself, as the Sailing Stars. Besides its Hebrew name, Kimah, heap or cluster, it is possible it may be referred to in the obscure name, *Succoth-benoth*, booths (or tents) of daughters (2 Kings xvii. 30); according to the Rabbis, The Hen and Chickens; and Aben Ragel, quoted by Hyde, says, 'the Pleiades, a lunar mansion in the Sign Taurus, is called the celestial hen with her daughters.'† It is not unlikely that the Babylonian and Assyrian gods enumerated in the above passage, had originally reference to the sun and stars. Eastern tradition, for example, makes Orion the deified Nimrod which *Nergal* is supposed to have been.

The parentage and designations of the Pleiades are sufficiently obviously suggestive of the redeemed family; ‡ and the situation of this unique group on the Bull's shoulder, upheld as it were by his strength, and closely following Aries, is one of the fittest places in all the sphere for such an emblem, if we accept the interpretation of the signs as given in Mazzaroth. It seems also to be watched by the monster Cetus; and Pindar, in his play upon the Greek words for 'mountain' and 'Orion,' unconsciously expressed a spiritual truth:

> "Where shines the mountain Pleiad's star,
> 'Tis like Orion is not far."—Nem. ii. (Cary).

Orion and the Pleiades are mentioned together in Amos v. 8:

> "Seek him that maketh Kimah and K'sil."

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* On the Indian sphere, the six Pleiades are nymphs, called Kritica, nurses of Kartikeya, the god of war, and they form the third lunar mansion.

† A similar appellation still exists not only in England, but in France, Germany, and Italy.

‡ The reader is referred to the appendices to the '*Astronomical Register*,' Vol. 5, 1867, and Vol. 8, 1870, for previous observations on the emblems of the signs of the Zodiac, and other constellations.

It will be remembered too that seven (the number of the Pleiades), is often used in Scripture as the number of perfection (See Cruden's Concordance). That the Pleiades were anciently of great importance, appears by their being a distinct constellation in Aratus: by one of the Arabic names for them, *Al-najm*, the Star, and by evidences of a primitive astral year regulated by them. *

In Odyssey XII. 62, &c., Homer mentions the Plangtai or Wandering Rocks, which coming together crushed whatever came between them. Not even birds could pass through; 'not even the timorous doves which bring ambrosia to father Zeus, but the smooth rock always takes away (one) of them; but the father sends among (them) another to make up the number;' Athenæus (xi. 79) understood the Pleiades to be meant; and thus C. O. Müller takes it. The former (xi. 82) says, Homer hints in a poetical way that whilst six Pleiades are seen, still their complete number is preserved. The 'lost Pleiad' is explained either by actual variability in one of the stars, or by differences in the clearness of the atmosphere, or in the vision of different persons. Would it be refining too much if we conceived here the trace of something higher than a poetical allegory relative to the constellation? However this may be, assuming that we interpret rightly the symbolic meaning of that constellation, we are sure that no Pleiad is ever really lost; death indeed is apparently ever taking from their number,—despite of the ambrosia of which they are the bearers—but notwithstanding appearances their number is unimpaired, and their unalienable portion is "life and immortality."

With a very low power the Pleiades are a beautiful telescopic object. Smyth (*Cycle*) remarks that "they have a singularly brilliant light for their magnitudes," and Webb (*Celestial Objects, &c.*) notices "the remarkable absence of colour in the group." If the explanation here offered of its emblematic meaning † be correct, these physical features taken in connection may contribute to the interest with which we contemplate one of the chiefest ornaments of our skies.

"The Dog of Orion," says C. O. Müller, "is a lucky combination of the ante-Homeric times, by which a dog, already stationed in the sky, was brought into connexion with Orion, the God of Hunting; so that, when the Bear was viewed as the hunted animal, a mighty chase, which was afterwards developed still more, swept over the entire heavens. The bright star which the Greeks call the Dog, and the Romans *Canicula*, is, with the exceptions of the sun and moon, *the only one*, so far as I can discover, *that occupied an important rank in the worship of the Greeks.*" * * * * "All this goes to prove that the dog, as a symbol of Sirius and the glowing heat of summer, was employed in festal ceremonies and mythi from a very early period, and that this star was at least supposed to have something of the nature of a dæmon." He thinks that the direction of the Dog must have been formerly different from what it is now.‡

Some corruptions in the symbolism of the stars are probably as old as Nimrod, whose name is associated in Oriental tradition with the constellation of Orion. It is not unlikely that the neology which changed the original emblem of those glorious stars, and made of them the figure of a giant hunter, transformed the neighbouring emblems to bring them into unison with the alteration; and we may hesitate there-

* Haliburton quoted in Piazzi Smyth's *Life and Work at the Great Pyramid*, Vol. 3.

† This is the view of the writer of "Mazzaroth;" but in that work made to rest too much on (at least) precarious and questionable Hebrew etymologies.

‡ "*Scientific System of Mythology*," by Leitch.

fore to accept the two Dogs* and the Hare as having formed part of the primeval sphere. Yet if we set them aside it is not easy to substitute other figures with any very firm conviction that we are right. Scripture here affords no light; and the perusal of the long and learned note in the *Cosmos* of Humboldt (vol. 3, note 218) on the variously assigned etymologies of Sirius—Coptic, Zend, Sanskrit, and Greek—leaves us still in doubt. Max Müller's remark there quoted, is doubtless correct, that "the Indian astronomical name for the dog-star, Lubdhaka, which signifies 'hunter,' regarded in connection with the neighbouring constellation of Orion, seems to point to a highly ancient Aric community of view in the contemplation of this group of stars."

The following considerations may perhaps assist us in the search for the original figures of at least two of the constellations in question: 1. They were probably some other animal or animals converted afterwards into dogs. 2. Their close proximity to Orion seems to require that their symbolic meaning should be such as to harmonise with that which there is good reason to believe belongs to that peerless asterism. 3. It is not likely that the brightest star in the heavens should be an emblem of any one but the Redeemer. First then, let us try a *Semitic* etymology for Sirius. The Arabic *Shi'ra*, it will be remembered, is applied to both Sirius and Procyon. May not the original have been the Hebrew *Sa'ir*, a he-goat? The word means primarily *hairy*, *rough;* and this is also the meaning of the Arabic *Sha'ir*. Sa'ir is the frequent designation in Scripture for the goat of the sin-offering (see Leviticus and Numbers passim, and especially Lev. xvi., about the great Day of Atonement), and is peculiarly stamped with a sacrificial character. It is easy to recognise the appropriateness of the juxtaposition of the emblems of the Atoning Victim and the glorified Saviour. Thus interpreted, Sirius and Orion remind us of the "sufferings of Christ and the glories which should follow" (i. Pet. i. ii.); and the most brilliant of all stars also testifies to what we know on infallible authority, that the ATONEMENT will never lose its place as the great central fact in the counsels of God; and so far from being obscured by the glories to which it leads, will ever be in its memorial a conspicuous and integral part of them (Comp. Rev. v. 6. xxi. 22, 23. xxii, 2). To emphasise the expression of this truth; to picture the intensified appreciation of the vicarious sufferings of the Redeemer at the time when His glories shall be revealed, it may have been that *two* goats were placed by the grand starry emblem that to those glories seems to have been consecrated.

It would be rash, nevertheless, to claim for the above explanation more than a certain degree of verisimilitude. Compared with the other symbols which have been reviewed, the evidence for this one is confessedly weak.† The Dog, "ante-Homeric," as he is, does not apparently admit of any application to Him whose other animal symbols are so suitable and easily recognised; and as little does the position and attitude of the figure, and the unrivalled brilliancy of its principal star, admit of its application to the evil one. Instead of having been "already stationed in the sky" before Orion, it was probably coeval with the innovation which introduced Nimrod there. We appear then to have good ground for dismissing this figure, though by reason of its high antiquity and associations, with some reluctance. But we can feel by no means equally confident in our attempted reconstruction. Still, considering the vexed

* "The two Dogs," observes Smyth, "were anciently in closer connection, but the intrusion of Monoceros between them by Hevelius, has parted them." (*Cycle* 2, 183.)

† The writer of "*Mazzaroth*" refers Sirius to Messiah, but assumes another derivation of the name from the Hebrew *Sar*, a Prince.

etymology of this famous star, the derivation above proposed (equivalent to the Latin, *hircus, hirtus, hirsutus*) has the merit of indicating that the change from the dog to the goat, or from one "hairy" or "shaggy" animal to another, was not a violent one; and possibly suggested to the dwellers in the land of Shinar, the "lucky combination," as Müller calls it, which furnished their mighty hunter with a dog for the chase.*

Worshipped by Greeks and Arabians; by the former "appeased by continual sacrifices"; † with a bad name embalmed in the verse of Homer, and pervading all antiquity; even now associated with popular error; it is not with unmixed feelings,—reflecting on the past—that we gaze upon the Dog-Star; and still more, if indeed it was once and primarily a memorial of the most precious of all truths, we cannot but deplore the perversity that so degraded its primeval symbolism, and made it an object of idolatrous superstition and groundless fears.

As to the Hare, there is something incongruous in this little animal being placed beneath the feet of Orion, even regarded as a mighty hunter: though it has been attempted to be explained as emblematic of caution and celerity. It is probably also a corruption, and perhaps the original emblem may be indicated by the Arabic name for its principal star, the "throne of Jauza" (*i.e.* of Orion).‡

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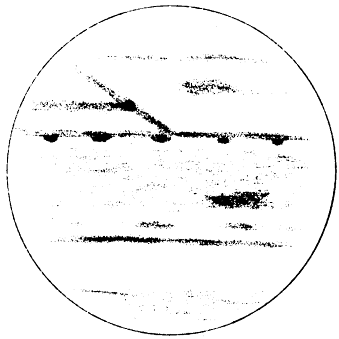
* On page 1 of Vaux's *Nineveh and Persepolis*, is figured "a beautiful representation of a dog, preserved in relief, on a thin piece of tile." It was found by Colonel Rawlinson in excavations made at Birs-i-Nimrûd. Whether or not its antiquity is as high as the Assyrian empire, which Mr. Vaux questions, the fierce and powerful animal, held in a leash by his keeper, who holds a short thick stick in his other hand, is no doubt a better representation of Nimrod's dog than the drawings of "Canis Major" on our globes and maps.

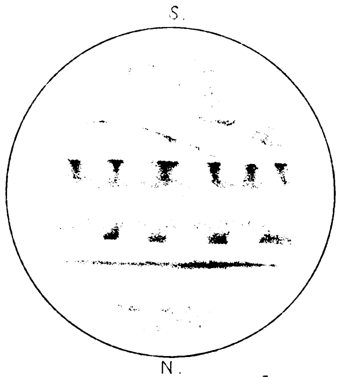
† See Müller's *Scient. Myth.* "Astronomical Mythi."

‡ See however "*Mazzaroth*," Part 2, p. 31.

JUPITER.

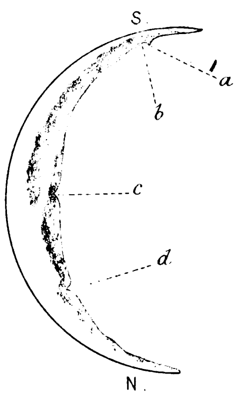


By Mr. J. Birmingham, Jan. 1872.



By Mr. H Pratt, Jan. 6th 1872, 10h.

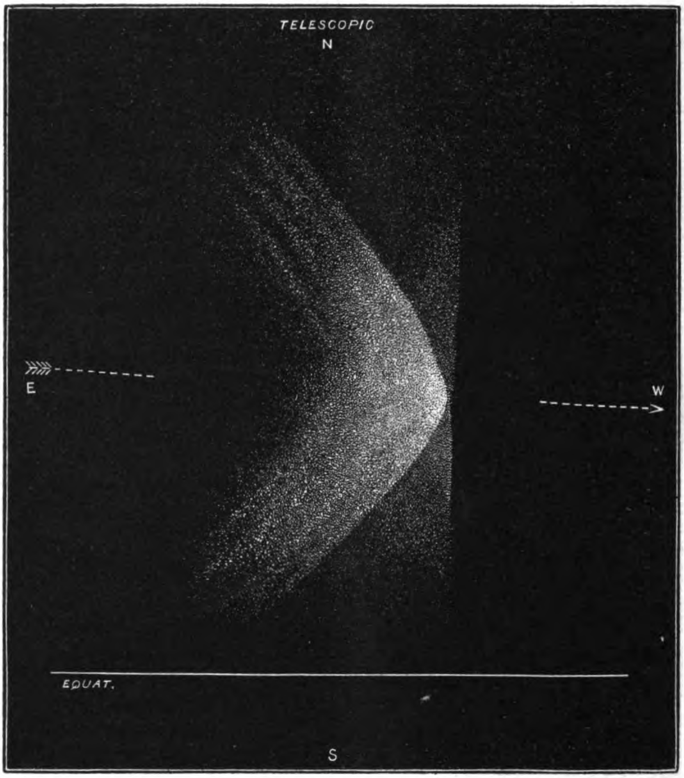
VENUS.



By Mr. H. Pratt. Jan. 29th 1870. 5h.

ENCKE'S COMET,

AS SEEN AT THE ROYAL OBSERVATORY, GREENWICH.



From a Drawing by MR. CARPENTER.

The Astronomical Register.

No. 110. FEBRUARY. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Third Meeting, January 12th, 1872.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. Thirty-nine presents were announced, and the thanks of the Society given to the respective donors. Attention was particularly drawn to two copies of the account of the *Great Trigonometrical Survey of India* and to Schellen's *Spectrum Analysis,* translated by The Misses Lassell and edited by Dr. Huggins, and, it was stated, that the author had expressed his extreme satisfaction at the manner in which the work had been rendered into English.

C. Ragoonochary (Madras Observatory),
W. B. Kemshead, Esq.,
W. Godward, Esq.,
F. J. Marriott, Esq.,
J. H. Winter, Esq., and
C. F. Plant, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Occultation of Vesta, December 30th, 1871: by Mr. Talmage.

The day had been very wet, but it became very clear at 9h. 30m. p.m. The planet Vesta was quite bright up to the moon's limb. The immersion took place at the bright limb at 10h. 44m. 24·8s. G. M. T., and the emersion at the dark limb at 11h. 52m. 52·6s. G. M. T. These times are exact. Power 80 on 10-in. refractor.

A suggestion on the use of Chronometers: by Mr. D. Gill.

As equal increments of heat do not make equal alterations in the position of the weights of a chronometer balance, there is a resulting uncompensated effect, like the irrationality of the spectrum in a telescope.

Chronometers, adjusted for extreme temperatures, will fail in mean temperatures, and *vice versâ.* Attempts have been made by Hartnup, Loseby, and others, to correct this, but they are not entirely successful. The author suggested the employment of another chronometer, in the same box, which he called the *chronometric-thermometer*, and should be either entirely uncompensated, or have the brass and steel portions of the balance reversed, so as to exaggerate the effects of temperature. This having had its rates in different temperatures tabulated, could be used to correct the other chronometer. He threw out the idea as more especially connected with the expeditions to observe the transit of Venus.

Capt. Noble thought greater perfection could not be reached in the chronometrical determinations of longitudes than in the Astronomer Royal's determination of that of Valentia, which, being afterwards checked by telegraphic signals, came out absolutely identical.

The Astronomer Royal said that, as to the fraction, the chronometer longitude was between the two galvanic results. He need not say that the subject of chronometers occupied much of the attention of all connected with Greenwich Observatory, and that, nine times out of ten, chronometers, when wrong, were so through changes of temperature. Generally, they were now over-corrected; but, formerly, the reverse was the case. This was as to the primary or principal correction. Mr. Gill's paper referred to the secondary alteration. Many years ago this was the subject of communications to the Royal Society by Mr. Eiffe and Mr. Molyneux, which were referred to a committee. Both provided means for this auxiliary compensation which did so approximately. Since that time, other plans have been proposed, notably by Mr. Poole, whose chronometers have gained the first

prizes. As to Mr. Gill's suggestion of another chronometer, he did not think any navigator would be troubled with it. One was enough to look after. He would recommend makers to turn their attention to obtaining greater delicacy in the primary compensation. It was well done up to a certain point; but, in the last delicate shade lay the difficulty, and where the difference between high and low temperatures and the mean had to be provided for.

The President inquired whether this was not accomplished by Mr. Hartnup's balance?

The Astronomer Royal said: Not better than by others.

The President thought this nearly perfect.

The Astronomer Royal believed the greater number of the best chronometers were Poole's. He (Mr. P.) made for the trade, so that his balances were sometimes found in instruments bearing other names.

Mr. Gill said, he certainly did not propose his plan for general adoption in navigation, but thought that in any chronometric longitude expeditions no trouble would be considered too great. Mr. Hartnup had recommended him to turn his attention to the subject.

The Astronomer Royal presumed Mr. Gill was aware the plan was used at Greenwich. He also remarked that nobody can appreciate how much depends on the oil. This is a radical point requiring attention. When the oil freezes chronometers go wild.

Professor Cayley mentioned that, with regard to his paper at the June meeting on De Launey's expression *l.g.h.* M. De Launey had accepted his values of the above symbols, and had extended them several terms further.

On the total Solar Eclipse of 1871: Extracts of a letter from Col. Tennant, R.E., to Dr. Huggins.

The author wrote in great haste, on the day of the eclipse, to save the post. The principal points noted were, that six photographs had been taken, and that one having been accidentally injured, five good ones remained. That the chromosphere and prominences first appeared white and then changed through pink to red. Col. Tennant saw two rifts which appearad to him not to reach the moon's edge, but were separated by some minutes of bright corona. The chromospheric* layers were undoubtedly radiated, but not coloured. There were alternate gradations of light—that is, light and comparative darkness, but certainly no colour. The rays were lost as they neared the moon. The rift, at the true vertex of the sun, he is sure, did not change, nor does he believe did any others. The telescope used for these eye

observations was of $2\frac{1}{2}$-in. aperture, and power 35. Capt. Morant, observing with a telescope of 1·75-in. aperture, made two sketches. He expressed himself positive as to absence of colour and permanence of rift. He thought, however, that the shades were of sepia tint (brownish), and that the rifts did extend to the moon. Col. Tennant desired to thank Mr. Brothers for his good arrangement of the dark slides.

Dr. De la Rue said that the eclipse of 1871 offered the opportunity of collecting a number of interesting facts along a very extended line. Mr. Ellery, in Australia, had organised some very extensive operations, which it was to be hoped were successful. We knew Col. Tennant had succeeded, and he hoped M. Jansen and the British Association expedition had also prospered. The Astronomer Royal had recently discussed the observations of 1860 and 1870, and the Council trusted that he would allow this report to be published, as part of the Society's transactions. They had also taken action to obtain the observations of the expedition originated by the British Association, and hoped to succeed. The great number of eclipse observations now available must largely increase our knowledge of the physics of the sun.

The Astronomer Royal said that he personally had not done much in discussing the reports of 1860 and 1870. The Joint Committee of the Royal Society and Royal Astronomical Society had asked him to undertake the task, but he had stated that all he could do was to superintend the operation, if some one else would do the real labour, to which the Committee agreed; and Mr. Ranyard had gratuitously undertaken this work, and performed it with an ability that could not be exceeded. He has proceeded so far as to be able to report how many drawings would be required, and had devised modes of comparison which had not occurred to the Astronomer Royal, and which brought out things not before suspected. As the work was going on so well, he had applied to the Treasury for assistance to publish it, but the answer was that they would do nothing at all towards it. This must be looked at charitably, as he thought it meant that they did not want to become publishers of anything, and he had therefore intimated that he only wanted such assistance as had before been given, and the last letter from the Government asked for further information on this point. This he was collecting, and should lay before the Treasury, and he hoped they would see that a great deal of good work had been done, which was well worth publishing. If not, he had the ultimate resource of appealing to the Royal Astronomical Society and the British Association; and, if it could not be a national work, it would, doubtless, be brought out by these bodies.

Dr. De la Rue: The Council have to-day come to the determination that, if required, the Society will bear the whole expense of the publication, as it appears a most fitting time to discuss the result of these solar researches.

The Astronomer Royal was very glad to hear it, and thought the Council had done well in offering to incur this expense if need required.

Observations of Occultations of Stars by the Moon and Phenomena of Jupiter's Satellites: by the Astronomer Royal.

This was the usual annual summary of such observations at Greenwich.

Proposed devotion of a Special Observatory to observations of the phenomena of Jupiter's Satellites: by the Astronomer Royal.

The position which the Royal Astronomical Society holds qualifies it to assume the direction of observations to be made, and I venture to suggest that one observatory should be permanently devoted to the phenomena of Jupiter's satellites. It is known to students of the theory of gravitation, that the system is very peculiar and the results startling, especially in the remarkable enchainment of the first three, and the effect of the mass of the fourth. Since the attempts to determine the mass of Jupiter by Pound, myself, and Bessel, the planet has been somewhat neglected. The errors of the tables are too large for rough time observations, and the observations of the differences are not sufficient to correct the tables by. They cannot be corrected one by one, but must be done altogether. The phenomena occur at irregular times, and interfere with meridional work, although there are long intervals of holiday. The eclipses of the satellites are of the first consequence, and next the shadows on the disc. For this we have the authority of Laplace, and one calculation gives the times of both. The transits and occultations are also good, but require separate tables. The phenomena are very interesting to observe, and something fresh might be detected. I, therefore, recommend that any new observatory should be devoted to this class of observation, and then it may become in future times as well known for its work upon Jupiter's moons, as Greenwich is for its perseverance with respect to our satellite.

The Astronomer Royal, after reading his paper, said that remarks had often been made at the Society, as to the errors of the *Nautical Almanack* tables of these phenomena, but the correction involved more than was generally imagined. And, first, with regard to the theory. Until this had been pursued to its utmost extent, it was useless to attempt to improve the tables. These exhibited a number of terms symbolised by letters, as m, a, e, etc.,

which had to be multiplied by astronomical coefficients. The letters were mere unmeaning algebraic signs, until their numerical values were determined from old observations. The labour of this was almost incalculable. Mr. Dunkin could speak as to this work in connection with the great reduction of the lunar observations, from Bradley's time to 1830, and afterwards carried on to 1853. The mass of work carried on for several years was enormous. Of one large broadside for calculations, as big as a gravestone, 18,000 were ordered at first, and 4,000 more were required afterwards. This was only one of many forms, and, until they were all filled up, we were not in a position to give any values to the constants. This was by far the largest work which had been undertaken in astronomy. The lunar theory had been worked out by Laplace, Plana, and Lubbock, and having then got the value of the constants, tables could be constructed from which the places of the moon were predicted. The formation of these tables had been undertaken by Hansen, who had laboured hard at them, and his services had been acknowledged by the British Government. The reduction of the observations cost £3,000, and when all this was done, came Mr. Hind's work to make the calculations for the *Nautical Almanack*. If anyone, says Mr. Hind, ought to give better predictions, he can say somebody ought to first give him better tables, theory, and other means of improving his predictions. Laplace worked out the theory of Jupiter, and Delambre and others made the tables. To do better we must go all over the work again, and compare all the observations with the predictions. At present we do not possess sufficient materials, and this is why the observatory is suggested. The lunar theory also required revision as to the points discussed by Adams and Hansen, and the Astronomer Royal wished he were a younger man to undertake it. The Greenwich observations supplied ample means. The next thing was the theory of Uranus, and the observations for this purpose were abundant. In the third place, the theory of Jupiter wants a little working-up, but the main want is that of observations. A new observatory should take up this subject, which is not at present systematically touched.

Capt. Noble said that he should go away, to-night, with a light heart. He had at last got what he had been hammering at for so long—a reason for not doing the work required. So long as it was stated that money was wanted to employ computers, he felt that the government ought to be pressed to find it, but if observations were wanted, time must of course be allowed for their accumulation. As to Uranus, as the observations were sufficient, and mathematicians in plenty, the nation ought to pay any money required, to avoid the disgrace of our tables being six minutes in error.

Mr. Dunkin said the error in the tables of Uranus was only thirteen seconds of time.

Capt. Noble: I speak of the errors of occultations and am perfectly right.

Professor Cayley: We seem to want some sort of board, whose business it should be to work-up the theory and use the observations made.

Capt. Noble did not see why this should be the only country obliged to go begging for its tables.

Dr. De la Rue said that the Astronomer Royal had made a most valuable suggestion. It was necessary to collect materials, and, therefore, a new observatory had been proposed; but, in his opinion, there were observatories enough, and one could well be spared for the work on Jupiter's satellites. It should have a large equatorial, and accurate time and continuous work must be the rule, that no phenomena might be neglected. If this were done for ten years, ample materials would be collected, and then the calculations might be commenced.

Capt. Noble suggested that some guarantee should be given that the observations would be used, and that there should be two such observatories to escape the chances of bad weather.

Dr. De la Rue said no guarantee was necessary, they were sure to be used, and suggested that the telescope should be an 8, 9, or 10-in. achromatic.

Remarks on the Planet Jupiter: by the President (Mr. Lassell.)

As the fourth satellite has begun again to cross the disc, the author observed it on the night of December 30, 1871, and watched part of the passage. At the first entrance on the planet the satellite was hardly distinguishable from the disc, but as it advanced it grew darker, and by the time it was one-fourth across it was almost black. In fact, had Mr. Lassell not known better he would have taken it for a shadow. He had seen the same thing many years ago, but doubts whether it was so dark then. As this can only be an effect of contrast, it shows the brightness of the planet. In like manner, the spots on the sun would not be so dark anywhere else than on the brilliant surface of that body.

On this occasion Mr. Lassell had a most rare and exquisite view of Jupiter, and made a beautiful coloured drawing, which was exhibited. He had been disposed to think the colour in recent pictures was exaggerated, but must now yield up that opinion. He also pointed out the advantage which a newtonian reflector has over a refractor in giving purity of colour. The powers used were 240, 430, and 579, but the latter was too high. The colour was seen best with high power. The full aperture of 24-in. was used. A pencil drawing was also sent for convenience of engraving, on which the colours were marked.

Dr. Huggins said that the President had informed him that Jupiter appeared coloured, but he had not been told what the tints were. He (Dr. H.) looked at the planet last night and made a sketch, which agreed generally with Mr. Lassell's. The reddish belt was a little too pink in his (Dr. H.'s) drawing, and he considered Mr. Lassell's as rather too yellow in the same place.

Mr. Ranyard said that, since the last meeting, he had found some more observations of colour on Jupiter in 1836-7 and 8 and 1848-9.

Rev. J. C. Jackson exhibited six pictures of Jupiter, enlarged from Mr. Gledhill's drawings, during the last months of 1871, and described their details. On January 9, 1872, there were many more belts to the south than had been seen before, and the colours were very bright.

On the probable seat of energy of the Eruption Prominences: by Mr. A. C. Ranyard.

The great velocities observed in the uprushes or vertical storms of the chromosphere were compared with the comparatively slow motions revealed by the spectroscope, as existing in the horizontal currents; and thence it was argued that the uprushes of vapour must be caused by explosions taking place at lower levels. It was suggested that solid masses may be projected upwards, and that the prominences may be vast eddies driven upwards in the wake of such projectiles.

In spite of the high temperature of the sun, calculated by Ericsson, at four million degrees Fahr., and by Secchi at three million degrees centigrade; it was suggested that the vast pressures within the solar globe may be sufficient to reduce many of the elements from the gaseous to a liquid and even solid state. Professor James Thompson's experiments on critical temperatures were referred to as showing that a small alteration of pressure might be the cause of an explosion, if the elements were near their critical temperatures. The prominence observed by Professor Young was instanced as being evidently driven upwards by an explosion.

Usually hydrogen forms the head of such eruption prominences, and they are often "*gonflé*" with heavier vapours at their base, as if a series of layers had been carried upwards in the order of their density. This was considered as affording proof that the cause of such prominences is not an uprush of dense vapour from below, or we should find the dense vapours by reason of their weight travelling furthest in the resisting medium through which they pass, and forming the head instead of the base of such prominences. The theory of impact of one layer upon another driving the outermost and lightest layer furthest was rejected.

Professor Graham believed that the amount of occluded hydrogen in the Lenarto meteor pointed to its formation in an atmosphere of hydrogen under great pressure, such pressure (if it was necessary to look to the sun at all as the laboratory where meteorites are formed) would not be found in the chromosphere, but must be sought for at greater depths. These considerations, taken in conjunction with the flashes across the chromospheric spectrum, observed by Zollner, Vogel, and Howlett, appear to render it probable that solid masses may be hurled from the sun in eruption prominences.

Note on Encke's Comet: by Rev. H. C. Key.

The author sent a number of drawings of the Comet, and stated that he thought the Greenwich picture not a correct representation, as it always, in his 18-in. reflector, preserved an elliptical appearance. He detected a nucleus, and also saw one or more faint rays in the position of a true tail.

On the identity of the Triple Star H. I. 13: by Mr. Hunt.

This paper and drawing were intended to prove the identity of the object in question with one of Struve's compound stars, as originally stated by Mr. Dawes.

On an early transit of Mercury: by Rev. A. Freeman.

Mr. Freeman has found at St. John's College, Cambridge, the records of the observation of the transit of Mercury in 1782, and sent a copy of the time observations made with a 46-in. telescope. Dr. Maskelyne tried to observe this transit at Greenwich, but was prevented by clouds.

On the variable star S Orionis: by Rev. T. W. Webb.

The author had suspected this star to be variable at the beginning of 1870, and was confirmed in his opinion about twelve months ago. It is now showing more variation than ever before, and being well situated for comparison, the changes are easily detected. There is a star of Mr. Baxendell's *d* south preceding, of 11·1 magnitude, and another *e* north preceding, of 11·5, *f* 11·6 is nearly following; *g* on the north is 11·7, and there are two others, *h* and *k* of 12·5 and 12·6 magnitudes. On 5th December last, S Orionis was much fainter than *d* and *e*, and smaller than *f* and *g*, but brighter than *h* and *k*. It may, therefore, be estimated as a little higher than the 12th magnitude, with a period of less than twelve months; but it requires further examination, as it may not yet have attained its minimum.

Mr. Gibbs, Mr. Lynn, and Mr. Perigal having been duly appointed auditors, the meeting adjourned.

Erratum in last Report, page 3, line 17. The time 1m. 18.7s., mentioned by Capt. Noble, was not that of his last glimpse, but the difference between the observed time and that predicted by the *Nautical Almanack*.

THE APPROACHING TRANSIT OF VENUS.

Mr. J. Carpenter, in *Nature*, gives a very interesting account of the preparations being made for the approaching transit of Venus, from which we learn that in Russia a committee has been formed, under Professor Struve, to furnish a chain of observers, at 100 miles apart, along the region between Kamtschatka and the Black Sea. The principal German astronomers have determined to furnish four stations for heliometric observation of the planet during its transit, one in Japan or China, the others probably at Mauritius, Kerguelen's, and Auckland Islands. Three of them, and one station in Persia, between Mascate and Teheran, will be equipped for photographic observations. What the French will do is uncertain. Before the war, it was suggested that they should establish observing stations at St. Paul's Islands and Amsterdam, Yokohama, Tahiti, Noumea, Mascate, and Suez.

It is gratifying to hear that our own preparations are in a more advanced state than those of any other country. The writer goes on to remark that there are several methods by which observers at opposite points may measure the parallactic displacement on the sun's disc—1st, by durations of transit (Halley's method); 2nd, by absolute local times of ingress and egress (Delisle's method); 3rd, by heliometric measures of the planet referred to the limbs of the sun; 4th, by similar measures obtained from photographs of the sun with the planet on his disc. The Astronomer Royal, as a first step, set down stations best applicable for the second method, as that which demanded foremost attention. These had to be selected in order to combine a sufficient altitude of the sun with the maximum attainable acceleration of ingress and retardation of egress on one side of the earth, and retardation of ingress and acceleration of egress on the other side of the earth. Upon weeding out such of these stations as might be expected to be occupied by foreign and colonial observers, it was determined that five stations ought to be equipped by the English Government—viz., Woahoo (for observation of accelerated ingress), Kerguelen's and Rodriguez Islands (for the retarded ingress), Auckland, in New Zealand (for the accelerated egress), and Alexandria (for retarded egress).

Of each of these places the exact longitude must be found, as the absolute local time of the phenomenon is required in each. This will immensely increase the extent of preparations necessary, including the sojourn of the observers for three or four months at each.

To determine the longitude, the Astronomer Royal has determined to employ the method by vertical transits of the moon, the instruments for which observations are to be altitude instruments with 14-in. circles and telescopes of 20-in. focus. For time determinations he proposed 3-in. transits of 36-in. focus, with clocks of moderately high class. For the phenomenon itself each station is to have a 6-in. equatorial and a 4-in. portable telescope. For these an observatory of three rooms will be required. Most of the instruments had to be made on purpose, an estimate for which, to the amount of 2,154*l.*, was submitted to the Admiralty. Supplementary estimates, for conveyance, residence, pay, &c., were prepared by Admiral Richards—viz., for the Woahoo detachment, 2,500*l.*; to Rodriguez and Kerguelen's, 2,000*l.*; for Auckland, 1,000*l.*; Alexandria, 750*l.*; making a total of 8,250*l.*

In 1869 a total of 10,500*l.* was asked for and granted by the Treasury. No time was lost to get everything provided. Most of the instruments and observatories are ready.

It was not at first intended to include photography, on account of uncertainties which were supposed to be inseparable from photographic measurements—but, though all doubt in their correctness has not been removed, yet, this having been done to some extent, through the labours of Mr. Asaph Hall and Mr. De la Rue, and as other nations had resolved to make use of the photographic method, at last it was determined that we should not neglect it, and so an additional 5,000*l*. was asked for and granted for this purpose, and the construction of five photo-heliographs was ordered of Mr. Dallmeyer, similar to that employed at the Wilna Observatory.

The object-glasses will be of about 4-in. diameter, giving focal images of the sun about ½-in. in diameter. The focal image will be amplified to about 4-in. diameter on the photographic plate, and in applying the enlarging lens, Mr. Dallmeyer is confident that he can entirely destroy the spherical aberration. The camera telescopes will be mounted on equatorial stands, with latitude adjustment of 80° range, and they will be furnished with driving clocks.

Mr. De la Rue will superintend the organisation of the photographic department, and supervise the construction of the instruments.

The three stations best suited for photographic observations are Rodriguez, Kerguelen's Island, and Auckland. It is not yet settled whether the heliographs provided for the two other stations might not be better placed elsewhere.

A NIGHT IN THE EAST.

From *A Month's Sojourn on Mount Olivet;* by Mrs. Finn, in *The Scattered Nation*, September, 1871.

Still, how enjoyable was the weather, up here in the mountain air! What could be more delightful than the fresh, dewy mornings, all fragrant with herbs and wild thyme. The still, clear heat by day; the afternoons, when the shadows began to lengthen; the moonlit nights, of surpassing brilliancy, when all the city and the marble courts of the Temple, with airy columns and dusky cypresses, slept in loveliness, unmarred by ought that could disturb eye or ear.

The dark, starry nights were equally enchanting. The evening star that month was Jupiter; after watching him, and finding out his satellites, with help of the telescope, I sought out each bright star with the glass. Presently, having got within range, a planet of tawny hue,—how delighted was I at being able to distinguish the ring of Saturn—the separation between it and the planet, fine as a hair, yet perfectly visible.

Another night, or rather morning, while it was yet quite dark I was awoke by a light streaming in upon my face through the little window that looked eastward, over the shoulders of Olivet. The light came from Venus; there the morning star, gleaming in unearthly beauty, like a small, full moon, over the mountain. By her light alone we could see each other distinctly, and I was able to read the hour upon a small watch.

Long before daylight we were up on the roof-terrace, watching the glories of the firmament. In Jerusalem, the Milky Way has none of the hazy indistinctness which it has here, but spans the sky from side to side, a complete and lustrous bow of stars.

Nothing broke the circle of our horizon. Much as if we had been at sea, or on some wide plain, could we here, from the mountain tops, see

the wide expanse of heaven, and watch the constellations from their rising to their setting, in all their liquid and dazzling effulgency which had met the eye of King David long centuries before, and caused him to exclaim, "The heavens declare the glory of God, and the firmament showeth His handy work. Day by day uttereth speech, and night unto night showeth knowledge." Sirius resplendent in the south over the Judean hills, Orion dipping towards the Mediterranean Sea, the Great Bear, the Pole Star, all the familiar constellations, marching onwards in majestic silence. There was to us no thought of sleep, or need of further rest that morning; the whole mind was too fully occupied with the magnificent spectacle, and with the multitude of overpowering thoughts.

Here were the stars as Abraham had seen them, when commanded to try and number them. Here were those ordinances of heaven spoken of by the prophet, "If those ordinances depart from before me, saith the Lord, then the seed of Israel also shall cease from being a nation before me for ever." These stars had silently looked down, as at this moment, upon all the momentous events which had taken place in this Land of Promise, from the night when Abraham looked at them, even until now. They had shone upon prophets, priests, kings, and apostles,—upon the Saviour Himself. They had been set forth as the emblems of the righteous, who shall shine as the stars of the heaven, in various yet in perfect glory. Here, beaming from Olivet over Jerus alem, was also the emblem of Him who is "the Bright and Morning Star" How pure and soothing was the light from this harbinger of day! There was no wind, the stillness was perfect.

Just before the first glimpse of dawn, this was broken by voices from the minarets in the city. Then came the primitive call to prayer, used in Oriental churches, by striking a wooden plank with a hammer. Thus attention was recalled to time present; the convent bell soon followed; then came pulsations of light, revealing battlements and mountain tops; then daylight, cool and grey; then a thousand lovely tints, upon the landscape and on the fleecy dew-clouds. The shadows fled away, and there appeared the sun-rising, with its magical effects of rosy transparency flung over the city in an instant of time. Just after that followed the bell of Christ Church, ringing the hour for Hebrew morning prayers, and the working day was begun.

Another morning, anxious to see the sun rise over the Moab mountains, we went early, at day dawing, to the eastern brow of Olivet, and thence looked down upon the desolate waste of hill and valley descending to the Jordan plain, lying lonely and sad in the morning light.

There was abundance of dew on all the plants at our feet; the air, clear and cold, was full of their fragrance. The dew was so heavy, that it actually moistened the limestone which peeps out here and there on the top of Olivet, and made it so damp and soft, that I was able, with finger and thumb, to break away the topmost layers, and carry off some specimens, in which fossil shells were embedded.

Far graver and more solemn than sunrise over Jerusalem, was the spectacle of sunrise over the Dead Sea waters, and the empty table-lands of Moab; yet there was exquisite beauty in the soft, lavender-grey tint of the whole landscape, relieved by a rosy cloud or two near the sun at his rising.

Sir John Herschel.—The following inscription, in brass upon a black marble slab, has been placed over the tomb of the late Sir John Herschel, in the north aisle of the Nave of Westminster Abbey.

Johannes Herschel
Gulielmi Herschel
Natu opere fama
Filius unicus
" Cœlis exploratis "
Hic prope Newtonum
Requiescit
Generatio et generatio
Mirabilia Dei narrabunt.
PSALM CXLV. 4, 5.
VIXIT LXXIX. ANNOS,
OBIIT UNDECIMO DIE MAII,
A.D. MDCCCLXXI.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

NOTES ON JUPITER.

January 9, 1872.—At 9h. 45m. p.m. the air was still, but very misty. With difficulty two drawings were made. The following points are noteworthy.

1. The zone between bands 2 and 3, which has for years been the brightest portion of the disc, is now, in some parts, the darkest. At the above time this zone was full of dark markings; and, together with the coloured zone immediately to the south, gave a very unusual aspect to the disc.

2. Band No. 2, which has for some years been the darkest and broadest, is now, in some parts, fainter than No 3, and some other bands to the south.

3. There was a very fine band to the south of No. 5.

4. And still further south, and nearer to the pole than I ever noticed a band before, was a very distinct broad band.

January 14, 10h. 20m. p.m.—At this time a drawing was obtained, and also one at 11 p.m. The first may be thus described:—

Band No. 2 was much as usual, broad, but not very dark. Between Nos. 2 and 3 was the new band extending quite across the disc; the space on each side of it was fairly bright.

Under No. 4, and in the centre of the disc, was a large ellipse with several small ones on each side of it.

The central zone has certainly lost some of its colour in some parts.

No. 5 was a very fine band, and had its south edge thrown into waves.

To the south of No. 5 a fine band which split up into two at the middle point: one fork ran on to the west parallel to the other bands, while the other diverged a little northwards.

The second sketch shows a series of bright oval spaces under No. 4; but the dark portions, which separate them from one another, are not at right angles to the band, but drift away to the N.E., and some of them seemed to extend quite across the zone in this diagonal direction.

This appearance strongly suggested that in the beautiful drawings of Dawes.

The zone between Nos. 2 and 3 was, at this time, full of grey cloud-like markings.

Mr. E. Crossley's Observatory,
Park Road, Halifax:
Jan. 15, 1872.

JUPITER.

Sir,—My only observations of Jupiter since April 3, 1871, were on the 11th and 13th of the present month when I was truly surprised at the changes in his belts and general appearance. From December, 1869, to the first of the above dates, though he exhibited some variety of feature on different occasions, there was nothing near so striking as the new formations that now appear over his disk. Jupiter's atmosphere, or whatever it is that we see as the face of the planet, appears certainly to be now going through a period of great disturbance, and with a marked progress even since the date of the last of Mr. Gledhill's drawings in your current number. This will be shown by the accompanying rough sketch where some new forms will be seen that up to the above date were not observed by Mr. Gledhill. Of these the most striking is the belt-like streak that descends from the south, crossing the truncated end of 5 at a sharp angle, and reaching down to 4. No. 2 did not seem so dark or so broad as it used to be, and between it and No. 3 was the new imperfect band exactly as described by Mr. Gledhill. The zone between 2 and 3, which formerly appeared to me of a bright greenish color, looks as if it were now about to be filled up and added to the broad dark equatorial zone, as it presents a turbid and mottled appearance on both sides of the new belt, and confuses the previously distinct outlines of 2 and 3. I have not tried to show this in the sketch. The bright zone lying north of 2 seemed to me broader than to Mr. Gledhill. It is probable that the north polar region appeared equally dark to us both, but the opposite area is much darker in Mr. Gledhill's views than I saw it. In fact, in neither of my late observations could I notice without considerable difficulty that it showed any shading whatever, besides some indistinct traces of a belt which I have not sketched.

The great equatorial zone used to appear to me of a rose tint, increasing in depth on each side from the centre where it was very nearly colorless. The centre and southern half of the zone are now equally of a dark shade of red, but the northern half degrades to a slaty hue, which continues across the turbid zone with the new belt between 2 and 3.

Jan. 15, 1872. J. BIRMINGHAM.

Sir,—On January 6, 1872, 10h. to 10h. 45m., the great southern white belt of Jupiter presented a very abnormal appearance. I have constantly observed the planet on all opportunities for the last few years, but have never before seen so fine a display. After several terrific gales and storms of rain here the atmosphere had settled to a calm, barometer low. The blue depths of the sky *very* dark. A little unsteadiness at times, but generally definition was exceedingly fine.

Through the middle of the equatorial zone ran a narrow paler band, distinguished not only by its tint, but by its freedom from the mottling which extended over all the darker parts af the zone one either side. On the southern margin of the equatorial zone, a few oval white spots were *very* conspicuous, the spaces between them deepening in tint in proportion to nearness to the southern white belt. The oval white spots appeared nearly detached from the white belt, and their edges were softened. The S. margin of the northern white belt was extended in four places over the equatorial zone, each having a soft cloudy aspect, and slanting N.E. and S.W. Faint shading between these was visible on the N. white belt, while its S. margin was traceable as a *dark line* in the interspaces. The northern white belt was divided its whole length by the darkest of all the belts, slightly widened on the E. The southern white belt was a grand mass of overlapping cloud-like streaks, which can better be understood from the sketch. On its eastern part, just coming into view, was a dusky marking, its western end having an oval outline. Two dusky oblique streaks were easy features, and on close examination they were found connected with a ramification of others. The tints of the various parts of the disc came out finely, and the N. white belt appeared *slightly* tinted with yellowish, as compared with the great S. belt and the cumuli-like shapes on the border, which appeared intensely white. Telescope equatorial, $8\frac{1}{8}$ With spec. Powers, 304 and 450.

Yours faithfully,
HENRY PRATT.

18, Preston Street, Brighton :
Jan. 16, 1872.

MARKINGS ON VENUS.

Sir,—The interesting discussion respecting the markings on Venus, which took place at the recent meeting of the R.A.S., and a letter upon the subject, which appeared soon afterwards in the *English Mechanic*, from Mr. Birt, remind me that I have been wanting in duty by omitting to record in the pages of the *Astronomical Register* an observation which may be interesting to others although now months old. The delay has been occasioned partly by pressure of my duties and partly from the idea that probably others would describe it. But, as I have met with no published notes of a simultaneous observation, I hasten to atone.

On January 29, 1870, 5h. aefinition was very fine and Venus exceedingly white. Both cusps very thin and sharp. The first feature which attracted my attention was a tooth of light near the S. cusp (*a*), evidently a spot on the terminator higher than the adjacent regions. It was rendered the more conspicuous by an indentation on one side close to its base (*b*). Other indentations of the terminator were easily seen, one near the equator (*c*), another nearly halfway between this and the northern cusp (*d*). Some delicate shadings were also visible. The sketch was made with the assistance of cross webs. Powers 180 and 270; 90 was insufficient. Telescope $8\frac{1}{8}$ equatorial With spec. The observation was repeated but not so easily, as the planet showed a slight colour on January 1, 1870, 5h. 10m.

Yours truly,
HENRY PRATT.

18, Preston Street, Brighton :
Jan. 16, 1872.

Ξ *URSÆ MAJORIS.*

Sir,—ξ Ursæ Majoris is now nearly at its periastre, and deserves the especial attention of observers. There were no observations made at its last periastre, in fact none between the years 1804 and 1825. The angular change is at present very rapid, being nearly at the rate of 1° per month. The distance is a little more than 1″.

Temple Observatory, Rugby. J. M. WILSON.

OCCULTATION OF VESTA.

Sir,—Thanks to Mr. Hind's timely announcement, as quoted in the pages of the Astronomical Register, I was enabled to observe, on the beautifully clear night of Saturday, December 30th, the emergence from occultation, at 11.54 p.m., G. M. T., of the little planet Vesta. It emerged from behind the moon opposite some rugged lunar scenery on the Terminator, a little to the north of the striking crater Theophilus, which latter was seen in great beauty at that period of the present lunation.

O.G. 3-in., power 120.

I remain, Sir, yours very faithfully,

East Tisted Rectory, Alton, Hants :
January 1, 1872. FRED. HOWLETT.

OCCULTATION OF VESTA—DARK TRANSIT ON JUIPTER, &c.

Sir,—I have to thank Mr. Buffham for his answer in No. 109, page 14, to my letter in the November *Register*, as to whether high or low powers are best suited for viewing faint stars, though I am sorry to say that my mental vision is not powerful enough clearly to *define* the whole "drift" of his letter.

As regards the occultation of Vesta on the 30th of last month, I was glad to view this asteroid directly after its emersion, through a small refractor of only 2⅝-inches (the night not being sufficiently fine for me to get out my equatorial), but with this small O. G. I failed (as anticipated) to see the immersion of Vesta.

On the same night I had a fine view of the transit of Jupiter's fourth satellite as a *dark spot*, I thought at first it must be a shadow, but on referring to the *N. A.* found otherwise. This transit was in fact distinctly seen as a dark spot (at least two-thirds as black as a shadow), and after an interval of more than 40 minutes from its immersion. I was rather surprised to see this phenomenon so clearly through so small an instrument, but perhaps it is not uncommon. Clouds soon afterwards "eclipsed" Jupiter, so that I could not watch this interesting transit any longer.

St. Aubin's Lodge, I remain, yours faithfully,
Downs' Park Road, Hackney : W. L. LANCASTER.
Jan. 20, 1872.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN FEBRUARY, 1872.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight.		Objects to be observed.
	° ′		
11 ...	140 45·2	...	Palitzsch, Hase, Frauenhofer.
12 ...	128 9·1	...	Magelhaens, Goclenius, Sautbech.
13 ...	116 1·1	...	Janssen, Lockyer, Fabricius (*a*).
14 ...	104 18·9	...	Delambre, Dionysius, Hypatia.
15 ...	92 58·4	...	Mt. Caucasus, Area IV. A eta Outline Map.
16 ...	81 54·6	...	Pallas, Bode, Ukert, Murchison (*b*).
17 ...	71 1·9	...	Purbach, Regiomontanus, Walter.
18 ...	60 14·9	...	Cichus, Cysatus, Delue.
19 ...	49 28·5	...	Mare Imbrium, the ridges on it (*c*).
20 ...	38 38·3	...	Hortensius, Milichius, Bullialdus (*d*).
21 ...	27 40·7	...	Wollaston, Sinus Roris, Sinus Medii (*e*).
22 ...	16 33·0	...	Zupus, Vieta, Sinus Œstuum (*e*).
23 ...	5 13·7	...	Rocca and objects near the East Limb.

For additional objects consult the lists for October and December.

Should any objects not be in sunlight they may be looked for on the following evening.

Linne.—Seeing that the transits of both terminators, evening and morning, over Linné are given on page 21 of the January number, and which will be extremely useful if continued, we may hope that when this interesting object is in sight *on the terminator*, advantage will be taken to examine it rigidly; it would tend greatly to advance our knowledge, and perhaps throw some light on the vexed questions concerning it, if observers were at once to publish their observations. See Vol. 9, pp. 82 and 234.

Lunar Tints.—As it is quite possible to determine by estimation the variation of Lunar Tints, it is recommended that a given surface of small dimensions should be compared from night to night with a neighbouring surface, the north of Julius Cæsar, for example, with Boscovich. An arbitrary scale may in the first instance be employed for this purpose. See article on Lunar Meteorology, on p. 22 of the January number.

(*a*) See note (*a*) in the September list, the crater on the S.E. of Janssen has been named Lockyer.

(*b*) Mr. Neison is still engaged in this interesting region. We would particularly solicit attention to a fine valley extending from a region just east of the group to the Apennines which Mr. Neison has pointed out; it is well seen as the terminator passes it, but is soon lost as the sun rises above it. The plain to the west of Pallas has been designated Murchison, commemorative of the late distinguished geologist.

(*c*) The systems of ridges on the Maria have not received the attention they deserve since the time of Schröter. They form interesting subjects of study.

(*d*) In the spring of last year, Mr. Whitley, of Truro, called attention to certain crater chains near Bullialdus, it is desirable that the locality should be carefully scrutinised.

(*e*) The aspect of these plains under a high light demands attention: clefts and minute craters should be looked for especially with large instruments.

The following objects constitute a zone, which with those given in the January list, may be observed between New Moon and the coming into sunlight of the magnificent zone characterised by Laugrenus, Vendelinus, Pitavius, and Furnerius. Subsequent to the 19th they will be west of their mean places, and may be observed with increased foreshortening as the evening terminator passes over them after the time of full moon.

Mare Humboldtianum, Mercurius, Berosus, Hahn, Oriani, Schubert, Lapeycouse, Phillips,* Legendre, Adams,† Mare Australe.

* Adjoining Wilhelm Humboldt on the east.
† South of Legendre.

Errata.

November 22, for *Uckert*, read *Ukert.*

January list, last line but two, for *Käshrer*, read *Kästner.*

In last line but one *dele* comma between Wilhelm and Humboldt.

In article on Lunar Meteorology, p. 23, line 31, for gradation of *that*, read gradation of *tint*. Same article, p. 23, last line but one, for *differences*, read *differently.*

In Report of the Hackney Scientific Association, Appendix, p. 3, line 26, for *Philip*, read *Phillips*. Last line but three, insert a period (.) after "named." Commence a new sentence with "Up," and insert in the next line the word "was," between moon and treated.

SUN.

Greenwich, Noon. 1872.	Heliographical longitude of the centre of		Heliographical latitude the sun's disc.	Angle of position of the sun's axis.
Feb. 1	308°·41		—6°·15	347°·66
2	321·59		6·21	347·25
3	334·77		6·28	346·85
4	347·96		—6·34	346·45
5	1·14		6·40	346·06
6	14·32		6·46	345·67
7	27·50		6·52	345·28
8	40·69		6.57	344·90
9	53·87		6·62	344·53
10	67·05	+40 $\delta\xi$	6·67	344·16
11	80·23		—6·72	343·80
12	93·42		6·77	343·44
13	106·60		6·82	343·09
14	119·78		6·86	342·74
15	132·97		6·90	342·40
16	146·15		6·94	342·07
17	159·34		6·97	341·74
18	172·52		—7·01	341·41
19	185·71		7·04	341·60
20	198·89	+50 $\delta\xi$	7·07	340·79
21	212·08		7·10	340·48
22	225·26		7·12	340·18
23	238·45		7 14	339·89
24	251·64		7·17	339·60
25	264·82		—7·18	339·31
26	278·01		7·20	339·04
27	291·20		7·21	338·77
28	304·39		7·23	338·51
29	317·58		7·24	338·25
March 1	330·77	+60 $\delta\xi$	—7·24	338·00

Adopted daily rate of rotation, 14°·20 + $\delta\xi$.

THE PLANETS FOR FEBRUARY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	19 25 33	—22 13½	5″·9	22 37·8
	15th	20 51 6	19 27	5″·2	23 8·1
Venus ...	1st	18 11 38	—21 51	15″·2	21 24·1
	15th	19 24 9	21 15	14″·0	21 41·3
Jupiter ...	1st	7 38 9	+22 1	43″·0	10 52·3
	15th	7 31 53	22 16½	42″·0	9 51·0
Uranus ...	2nd	8 3 31	+21 1½	4″·2	11 13·7
	14th	8 1 31	+21 7	4″·2	10 24·5
Neptune ...	2nd	1 22 14	+6 50	...	4 33·5
	10th	1 22 49	+6 54½	...	4 2·6

Mercury is well situated for observation at the beginning of the month.

Venus rises at the beginning of the month 2h. 20m. before the Sun, the interval decreasing.

Jupiter is well situated for observation throughout the night.

Uranus is also well situated for observation.

COMET V., 1871.

The following elements of this Comet are by C. F. W. Peters, of Altona.

Perihelion Passage ...	= 1871 Dec. 20·43	
	°	′
Longitude of Perihelion	=28	43
Longitude of Ascending Node	=146	45
Inclination	= 98	50
Longitude q	= 9.84587	

The following ephemeris will be useful to some of our readers in the Southern Hemisphere:—

1872.		R. A. h. m. s.		Decl. ° ′
Feb. 2	...	14 42 0	...	—84 43
12	...	8 25 18	...	73 40
22	...	7 46 42	...	51 32
March 3	...	7 39 6	...	26 26
13	...	7 39 30	...	12 47
23	...	7 43 49	...	— 1 46

ASTRONOMICAL OCCURRENCES FOR FEB., 1872.

DATE.		Principal Occurrences. h. m.		Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m. Jupiter
Thur	1	22 10	☾ Moon's last quarter Sideral Time at Mean Noon, 20h. 44m. 3·02s.	1st Tr. E. 1st Sh. E. 4th Tr. I.	6 34 7 0 15 37	10 52·3
Fri	2			2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	10 6 11 1 13 1 13 56	10 47·9
Sat	3	15 31 16 34	Occultation of ω Ophiuchi (5) Reappearance of ditto	3rd Sh. I. 3rd Tr. E. 3rd Sh. E.	6 36 8 11 10 6	10 43·5
Sun	4		Sun's Meridian Passage 14m. 8·97s. after Mean noon	2nd Ec. R. 1st Tr. I. 1st Sh. I.	9 3 36 17 7 17 38	10 39·1
Mon	5	17 32	Conjunction of Moon and Venus 2° 51′ N.	1st Oc. D. 1st Ec. R.	14 14 17 2 41	10 34·7
Tues	6	7 41	Conjunction of Moon and Saturn 2° 36′ N.	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	11 33 12 6 13 53 14 26	10 30·3
Wed	7	0 12	Conjunction of Moon and Mercury 2° 10′ N.	1st Oc. D. 1st Ec. R.	8 40 11 31 24	10 25·9
Thur	8	13 51	● New Moon	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	6 0 6 35 8 19 8 54	10 21·5
Fri	9			1st Ec. R. 2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E. 4th Oc. D.	6 0 3 12 23 13 37 15 18 16 32 23 41	10 17·1
Sat	10	2 54	Conjunction of Moon and Mars 4° 32′ N.	3rd Tr. I. 4th Ec. R. 3rd Sh. I. 3rd Tr. E. 3rd Sh. E.	8 2 9 50 38 10 35 11 31 14 5	10 12·7
Sun	11	4 28 5 24 7 41	Occultation of 33 Piscium (5) Reappearance of ditto Near approach of B.A.C. 17 (6)	2nd Oc. D. 2nd Ec. R.	7 28 11 39 44	10 8·3
Mon	12	9 22	Occult. of 26 Ceti (6½)	1st Oc. D.	15 59	10 4·0
Tues	13	20 16	Conjunction of Saturn and Venus 0° 33′ N.	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	13 19 14 1 15 38 16 21	9 59·6
Wed	14		Illuminated Portion of disc of Venus 0·773 " Mars 0·982	1st Oc. D. 1st Ec. R.	10 26 13 26 14	9 55·3
Thur	15	18 23	☽ Moon's First Quarter Sun's Meridian Passage, 14m. 24·97s. after Mean Noon	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	7 46 8 30 10 5 10 49	9 51·0

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Fri	16		Sidereal Time at Mean Noon, 21h. 43m. 11.34s.	1st Ec. R. 2nd Tr. I. 2nd Sh. I.	7 54 55 14 42 16 14	9 46·7
Sat	17	6 28	Near approach of ι Tauri (5) Saturn's Ring: Major Axis 34·50″ Minor Axis 14·13″	3rd Tr. I. 3rd Sh. I. 3rd Tr. E.	11 26 14 34 14 55	9 42·4
Sun	18	13 25 14 12	Occultation of 2 Geminorum (6½) Reappearance of ditto	4th Tr. I. 2nd Oc. D. 4th Tr. E. 4th Sh. I. 2nd Ec. R.	6 18 9 47 10 28 13 47 14 15 49	9 38·1
Mon	19	15 8 15 39	Occultation of ω Geminorum (6) Reappearance of ditto			9 33·9
Tues	20	6 41 20 42	Conjunction of Moon and Jupiter, 2° 10′ S. Conjunction of Moon and Uranus, 2° 36′ S.	2nd Tr. E. 2nd Sh. E. 1st Tr. I. 1st Sh. I.	6 46 8 27 15 6 15 56	9 29·6
Wed	21	13 29 14 31	Occultation of γ Cancri (4½) Reappearance of ditto	3rd Ec. R. 1st Oc. D. 1st Ec. R.	8 1 53 12 13 15 21 12	9 25·4
Thur	22			1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	9 32 10 25 11 52 12 44	9 21·1
Fri	23	22 56 12 33 13 2	○ Full Moon Occult. of 42 Leonis (6) Reappearance of ditto	1st Oc. D. 1st Ec. R.	6 39 9 49 55	9 16·6
Sat	24			1st Tr. E. 1st Sh. E. 3rd Tr. I.	6 19 7 13 14 54	9 12·7
Sun	25			2nd Oc. D. 2nd Ec. R.	12 8 16 51 50	9 8·5
Mon	26			4th Oc. D.	14 44	9 4·3
Tues	27			2nd Sh. I. 2nd Tr. E. 2nd Sh. E. 1st Tr. I.	8 8 9 8 11 3 16 53	9 0·2
Wed	28	13 40	Near Approach of 2 Libræ (6)	3rd Oc. R. 3rd Ec. D. 3rd Ec. R. 1st Oc. D.	8 9 8 38 42 12 2 0 14 1	8 56·0
Thur	29			2nd Ec. R. 1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	6 9 41 11 20 12 20 13 40 14 39	8 51·9
MAR Fri	1			1st Oc. D. 1st Ec. R.	8 28 11 45 2	8 47·8

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, Midnight			60°N.		0°		60° S.
			SUNSET.				
			°		°		°
1872. Feb.	1	...	− 3·2	...	− 1·0	...	+ 1·1
	2	...	15·4	...	13·2	...	−11·0
	3	...	27·6	...	25·4	...	23·2
	4	...	39·7	...	37·5	...	35·3
	5	...	51·9	...	49·7	...	47·4
			SUNRISE.				
	10	...	+71·7	...	+69·3	...	+66·9
	11	...	59·6	...	57·1	...	54·7
	12	...	47·5	...	44·9	...	42·5
	13	...	35·3	...	32·7	...	30·3
	14	—	23·0	...	20·6	...	18·1
	15	...	+10·9	...	+ 8·4	...	+ 5·9
	16	...	− 1·3	...	− 3·8	...	− 6·3
	17	...	13·4	...	15·9	...	18·4
	18	...	25·6	...	28·1	...	30·6
	19	...	37·7	...	40·2	...	42·8
	20	...	49·8	...	52·3	...	54·9
	21	...	62·1	...	64·5	...	67·1
	22	...	−74·3	...	−76·7	...	−79·3
			SUNSET.				
	24	...	+76·4	...	+79·0	...	+81·6
	25	...	64·3	...	66·9	...	69·5
	26	...	52·1	...	54·7	...	57·4
	27	...	40·0	...	42·6	...	45·2
	28	...	27·8	...	30·4	...	33·1
	29	...	15·6	...	18·3	...	20·9
March	1	...	+ 3·5	...	+ 6·1	...	+ 8·8

The sun's disc passes the true horizon of Linné—
On Feb. 15 from 6h. 7m. to 7h. 9m. G. M. T. rising.

THE PLANET VESTA.

The Minor Planet *Vesta*, whose occultation we recorded in No. 108, No. 4 of the series comes to opposition on the 5th of this month. She is in the constellation Leo, and is barely visible to the naked eye, her magnitude being between the 6th and 7th. The following are her positions at transit over the meridian at Greenwich.

		R. A.		Dec.
		h. m. s.		° ′ ″
Feb. 1	...	9 30 4	...	+21 32 59
5	...	9 26 4	...	22 4 3
10	...	9 20 59	...	22 40 58
15	...	9 15 55	...	23 14 48
20	...	9 11 5	...	23 44 42
25	...	9 6 39	...	24 10 6

JUPITER.

G. M. T.		Zenographical longitude of the centre of ♃'s disc. 6h.	8h.	10h.	12h.	14h.		Angle of pos. of ♃'s axis. 12h.
1872.		°	°	°	°	°		°
Feb. 1	...	289	2	75	147	220	...	11·08
2	...	80	153	225	298	10	...	11·03
3	...	231	304	16	89	163	...	10·98
4	...	22	94	167	240	312	...	10·93
5	...	173	245	318	30	103	...	10·88
6	...	323	36	109	181	254	...	10·83
7	...	114	187	259	332	44	...	10·78
8	...	265	338	50	123	195	...	10·74
9	...	56	128	201	273	346	...	10·70
10	...	207	279	352	64	137	...	10·66
11	...	357	70	142	215	288	...	10·62
12	...	148	221	293	6	78	...	10·58
13	...	299	11	84	157	229	...	10·54
14	...	90	162	235	307	20	...	10·50
15	...	240	313	26	98	171	...	10·46
16	...	31	104	176	249	321	...	10·42
17	...	182	255	327	40	112	...	10·38
18	...	333	45	118	190	263	...	10·35
19	...	123	196	269	341	54	...	10·32
20	...	274	347	59	132	204	...	10·29
21	...	65	137	210	283	355	...	10·26
22	...	216	288	1	73	146	...	10·23
23	...	6	79	152	224	297	...	10·20
24	...	157	230	302	15	87	...	10·17
25	...	308	20	93	166	238	...	10·14
26	...	99	171	244	316	29	...	10·11
27	...	249	322	34	107	179	...	10·09
28	...	40	113	185	258	330	...	10·07
29	...	191	263	336	48	121	...	10·05

Zenographical latitude 1°·0 North.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.

Barneby, T.
De la Rue, W.
Gill, D.
Huggins, Dr.
Ingall, H.
Lean, W. S.
Potter. T.
Prince, C. L.
Rivaz, Miss
Ryley, H. B.
Solomons, Messrs. S. & B.
Williams, H.

To Jan. 1872.

Woodman, T. C.

To March, 1872.

Dix, F.
Jackson-Gwilt, Mrs.
Price, J. G.
Wright, Rev. W. H.

To June, 1872.

Andrews, W.
Hemming, Rev. B. F.
Cook, J.
Hubbersty, Rev. R. C.
Jefferies, J.
Noble, Captain
Webb, Rev. T. B.

To Dec. 1872.

Backhouse, T. W.
Bates, T.
Bird, F.
Clarke, J. S.
Clermont, Lord
Collingwood, E. J.
Dancer, J. B.
Daw, E.
Ellis, W. M.
Glover, Rev. J. H.
Hannay, T.
Hedgeland, Rev. J. W.
Knott, G.
Lamb, Dr.
Mestayer, R.
Perigal, H.
Perry, Rev. S. J.
Redpath, H. S.
Roberson, C.
Terry, J.
Vernon, G. V.
Whitbread, S. C.
Wilson, J. M.
Wilson, T.
Worthington, F.

To Jan., 1873.

Shaw, Rev. J.

To Dec., 1873.

Warner, T.

To Dec., 1874.

Jones, W. E.

TO CORRESPONDENTS.

The Greenwich picture of Encke's Comet is unavoidably postponed.

It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 111. MARCH. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Fourth Meeting, February 9th, 1872.

The Annual General Meeting.

W. Lassell, Esq., F.R.S., *President,* in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last annual general meeting, and of the special general meeting for the alteration of the bye-laws relating to the award of the medal, were read and confirmed.

E. H. Cooper, Esq., D. L. Lowson, Esq.,
J. H. Esdaile, Esq., J. Martin, Esq.,
J. Engleson, Esq., Capt. O'Reilly,
Capt. Herschel. R.E., F.R.S., E. Roberts, Esq.,
and J. Wall, Esq.,
were balloted for, and duly elected Fellows of the Society.

The report of the Council (of which the following particulars are only a brief summary) was partly read by the Secretaries. It commences with the auditors' report on the treasurer's accounts, which show that the income for the past year was 1,410*l.* 4*s.* 2*d.*, and the expenditure, including the purchase of 200*l.* stock and the grant of 250*l.* in aid of the Eclipse expedition of 1870, was 1,138*l.* 10*s.* 7*d.*, leaving a balance of 271*l.* 13*s.* 7*d.*

The total number of Fellows and Associates is 552, being two less than last year.

The Council have awarded the gold medal to Signor Schiaparelli, of Milan, for his researches on the connexion between the orbits of comets and meteors. Part I. of Vol. XXXIX. of the *Memoirs*, containing a paper by Professor Cayley, "On the Graphical Construction of a Solar Eclipse," has been published, and a general index to the 38 volumes of the *Memoirs* compiled and distributed.

The list of deceased Fellows is long, and comprises some of the most distinguished men of science, including Sir J. Herschel and Mr. Babbage, the last survivors of the founders of the society in 1820.

The list is as follows:

Charles Babbage, Esq., F.R.S.
Capt. J. P. Basevi, R.F.
Rev. A. W. Deey.
Augustus De Morgan, Esq.
Lt.-Gen. Sir W. T. Denison, K.C.B., F.R.S.
Earl of Dunraven, F.R.S.
Commander R. W. H. Hardy, R.N.
Sir J. F. W. Herschel, Bart., F.R S.
Sir A. Lang.
Sir Roderick I. Murchison, Bart., K.C.B., F.R.S.
Admiral Sir W. Ramsay, K.C.B.
William Rutherford, Esq., LL.D.
Charles E. Smith, Esq.
Capt. David Smith.
Rev. W. Taylor, F.R.S.
Rev. T. W. Weare.

The report contained most interesting biographical notices of most of these Fellows, but extracts from two only, viz., those of Sir J. Herschel and Professor De Morgan, could be read. We may probably hereafter recur to some of them.

The reports of the various Observatories include Greenwich, Oxford, Cambridge, Dunsink (Dublin), Stonyhurst, Liverpool (Bidston), Kew, Durham, Edinburgh, Glasgow, the Cape of Good Hope, and Sydney.

At Greenwich, the printing of the reductions for 1870 is completed, and for 1871 far advanced. The water telescope has been used for observing γ Draconis, instead of the reflex zenith tube, with the results to be presently noted. The graduations and flexure of the transit circle have been re-examined, Jupiter's satellites, Venus, and Encke's Comet have been carefully observed in addition to the usual work. A new sidereal clock has been mounted in the magnetic basement, where the temperature is

nearly uniform, with the result of making any change in the clock rate almost inappreciable. What little alteration does take place seems dependent on atmospheric pressure.

At Oxford the regular astronomical and meteorological work has been carried on, the reductions well advanced in printing, and materials for a third catalogue of stars accumulated. The new transit circle at Cambridge has been employed in observing a zone of small stars, and some improvements have been made in the instrument. Encke's Comet has also been observed. Professor Chevalier has resigned the directorship of the Durham observatory. Minor Planets and Encke's Comet have been observed; also, the spectrum of the Aurora Borealis, but only the well-known green line was seen. At Dunsink, Dr. Brunnow has observed the parallax of five stars: 1,830 Groombridge, 3,077 Bradley, 85 Pegasi, 6 Draconis, and α Lyræ, the results of which will soon be published. He has also commenced work on the planetary nebula H iv. 37 and on 61 Cygni. A new transit circle is being erected. At Stonyhurst, the sun spots are photographed on a large scale, and a magnetic survey of Belgium has been made. A time gun has been established at Birkenhead (Liverpool), and nearly 400 chronometers tested. The weather having been very favourable at Kew, 381 photograms have been obtained on 226 days, and two papers, one on the form of the sun spot curve, and the other on its interplanetary relations, have been communicated to the Royal Society. The photographic operations for a spot period of 10 years have now been completed, and comprise 2,778 photograms and 20 papers. The observations at Kew will now be discontinued, but it is hoped will be kept up at Wilna, and probably, after an interval, will be resumed by Dr. De la Rue.

The report then deals with the progress of astronomy during the past year, and gives the greatest prominence to the important results of the late Total Solar Eclipse. With the exception of Australia, and one Indian station, the weather was most favourable and the reports most satisfactory.

The Madras astronomer, Mr. Pogson, observed at Avenashy. He telegraphed to the Astronomer Royal, "Weather fine, telescopic and camera photographs successful, ditto polarisation; good sketches; many bright lines in spectrum."

Colonel Tennant, who through the liberality of Lord Mayo had been able to organise a strong observing party, including Capt. Herschel and Mr. Hennessey, selected the old meteorological station of Dodabetta, on the highest peak of the Neelgherries, 8,650 feet above the sea. He telegraphed his principal results in the following words, "Thin mist, spectroscope satisfactory. Reversion of lines entirely confirmed. Six good photographs."

His subsequent letter was read at the last meeting of the society and duly abstracted in the *Astronomical Register*, and in the present number will be found a translation of Dr. Janssen's letter to the President, also quoted in the report.

From the British Association expedition the following reports have been received:

Mr. Lockyer, who observed at Bekul, speaking of the corona says, "Its rays arranged almost symmetrically, three above and three below two dark spaces or rifts at the extremities of a horizontal diameter. The rays were built up of innumerable bright lines of different lengths, with more or less dark spaces between; near the sun this structure was lost in the brightness of the central ring. I next tried the spectrum of a streamer above the point at which the sun had disappeared. I got a vivid hydrogen spectrum with 1474 (I assume the point of this line from observation) slightly extended beyond it, but very faint throughout its length compared with what I had anticipated, and thickening downwards like F. I was, however, astonished at the vividness of the C line and of the continuous spectrum, for there was no prominence on the slit; the spectrum was undoubtedly tho spectrum of glowing gas. In the Savart I saw lines vertical over everything, corona, prominences, dark moon, and unoccupied sky." With a simple train of prisms Mr. Lockyer saw "four exquisite rings with projections where the prominences were. In brightness C came first, then F, then G, and last of all 1474. The rings were nearly all the same thickness, certainly not more than 2′ high, and they were all enveloped in a line of impure continuous spectrum." "The structure of the corona was simply exquisite and strongly developed," I at once exclaimed, "Like *Orion*. Thousands of interlacing filaments varying in intensity were visible. I saw an extension of prominence structure in cooler material. This died out somewhat suddenly some 5′ or 6′ from the sun, and there was nothing. The great fact was this, that close to the sun, and even for 5′ or 6′ away from the sun, there was nothing like a ray or any trace of radial structure." At this station, five good photographs were obtained.

Commander Maclear observing at the same station says, "As totality came on, the light decreased and the lines increased exceedingly rapidly in number and brightness, until it seemed as if every line in the solar spectrum was reversed; then they vanished, not instantly, but so quickly that I could not make out the order of their going, except that the Hyd. D *b*, and some others between D and *b*, remained last. Then they vanished and all was darkness. I then unclamped and swept out right and left, but saw nothing; then went to the direct vision, but saw

nothing; placed the telescope on the Moon's limb by the eye-piece, then put in the spectroscope, but the light was not sufficient to show any spectrum; pointed the telescope carefully first on the dark Moon, and then on a bright part of the corona, but no spectrum. I then looked at the corona with the naked eye, saw a bright glory round the moon, stellar form, six-pointed, something like the nimbus painted round a saint's head, extending to a diameter and a half. Looked through the finder and saw the same form, but very much reduced in size and brilliancy, then examined with the 6-inch and eye-piece and saw nothing but a bright glow round the Moon, not much more than the height of the big prominence plainly visible in the south-east quarter."

Prof. Respighi observed at Poodocottah. He writes, "Towards the end of 1868 a small flint-glass prism was made for me by Signor Merz, of Munich, to be fitted to the object-glass of the equatorial of the observatory at Campodaglio. This apparatus, in consequence of the dispersion of the prism, and the goodness of the prism and object-glass, was found to be admirably adapted for observing the eclipse in the manner just described (that is, without a slit, so that the several chromatic images of the corona would be simultaneously seen in the same field of view).

"The dispersion of the prism from lines C to H is about 32′; the free aperture of object-glass is $4\frac{1}{8}$ French inches; the field of the telescope about 1°, with a magnifying power of 40." "At the very instant of totality, the chromosphere at the edge which was about to be eclipsed—surmounted for a space of about 50° by two groups of prominences, one on the right, the other on the left of the point of contact—were reproduced in the four spectral lines C, D^3, F, G. My attention was mainly directed to the comparison of the forms of the prominences on the four spectral lines, and I was able to determine that the fundamental form, the skeleton or trunk, and principal branches, were faithfully reproduced or indicated in the images, their extent being, however, greatest in the red, and diminishing successively in the other colours down to the line G, on which the trunk alone was reproduced. In none of the prominences thus compared was I able to distinguish in the yellow image D^3 parts or branches not contained in the red image C. Meanwhile the coloured zones of the corona became continually more marked, one in the red corresponding with the line C, another in the green, probably coinciding with line 1474 K, and a third in the blue, perhaps coinciding with F.

"The green zone surrounding the disk of the Moon was the brightest, the most uniform, and the best defined. The red zone

was always distinct and well defined, while the blue zone was faint and indistinct. The green zone was well defined at the summit, though less bright than at the base; its form was sensibly circular, and its height about 6′ or 7′. The red zone exhibited the same form and approximately the same height as the green, but its light was weaker and less uniform. These coloured zones shone out upon a faintly illuminated ground without any marked trace or colour. If the corona contained rays of any other kind, their intensity must have been so feeble that they were merged in the general illumination of the field. . . . . The spaces between some of the jets (prominences) were perfectly dark, so that the red zone of the corona appeared to be entirely wanting there. Perhaps, however, this was only an effect of contrast due to the extraordinary brightness of the neighbouring jets.

The discussion of these and other observations, and photographs when received, will, there can be little doubt, throw great light on the nature and extent of the coronal light and rays.

With respect to spectrum analysis generally, Dr. Zöllner has contrived a more simple form of reversion spectroscope, by which the principle of doubling the change produced in the refrangibility of a line can be applied to any spectroscope.

With this instrument Zöllner has succeeded, with the assistance of Dr. Vögel, Director of the observatory at Bothkamp, in detecting the change of refrangibility due to the Sun's rotation. The estimations of the amount of the change subsequently made by Dr. Vögel are in excess of the period of rotation obtained from observations of solar spots, the equatorial velocity ranging from 0·35 to 0·42 mile in a second, while the received value is 0·27 mile.

Professor Young was fortunate in observing an ejection of matter by an apparent explosion in the Sun, which took place on Sept. 7. At noon on that day he observed an enormous protuberance of hydrogen cloud on the eastern limb of the Sun. It had remained with little change since noon of the preceding day. It was made up mostly of filaments nearly horizontal, with its lower surface at a height of some 15,000 miles; but was connected with the layer of red hydrogen by three or four vertical columns, brighter and more active than the rest. Returning to the telescope half-an-hour later, Professor Young found, in place of the quiet cloud, a mass of detached vertical fusiform filaments rapidly ascending. Some of them had already reached a height of 100,000 miles, and they continued to rise with a motion almost perceptible to the eye until, in ten minutes, the uppermost were more than 200,000 above the solar surface, the

velocity of ascent was therefore 166 miles per second. Mr. Proctor has made some valuable suggestions as to the conclusions to be drawn from this occurrence.

Father Secchi has suggested a modification of the usual spectroscopic method of viewing the prominences which may be of service in some observations. He places a prism before the object-glass of the astronomical telescope, or else a direct-vision spectroscope within the telescope, some 6 or 8 inches in front of the slit of the ordinary spectroscope. By this arrangement the Sun's disk can be viewed in the spectroscope; and if the slit be placed on a prominence near the solar limb, and the spectroscope arranged for the position of C, then, together with the solar limb, will be seen a bright line of the prominence at a distance from the Sun's limb, depending on the position of the slit relatively to the solar image, but not exceeding the height of the prominence under observation.

We are also indebted to the ingenuity of Father Secchi for a new method of measuring the height of the prominences seen in the spectroscope, the details of which will be found in the *Comptes Rendus* for December 4, 1871.

Professor Young has done a very valuable service to spectroscopic observers of the Sun, by publishing a catalogue of all the lines which have been observed in the solar prominences and corona.* These lines, 103 in number, are arranged in the order of their wave-lengths, and the corresponding numbers of Kirchhoff's maps are given. Other columns of the catalogue contain the relative brightness and frequency of the lines, and the names of the chemical elements to which they belong. No fewer than twenty of the lines are due to the vapour of titanium. Besides the well-known coronal line 1474 of Kirchhoff's scale, two other fainter lines, one less refrangible than C, and the other between F and G, appear, according to Professor Young, to be persistently present in the corona or chromosphere, and probably to be due to the matter of which it consists, and not, as is the case with most of the other lines, to the occasional elevation of matter to heights where it does not properly belong.

Dr. Huggins has succeeded in observing the spectrum of the planet *Uranus*. His results differ in many important respects from those obtained by Father Secchi, in 1869. It will be remembered that Father Secchi described the spectrum of *Uranus* in the following terms, "Le jaune y fait complétement défaut. Dans le vert et dans le bleu il y a deux raies très-larges et très-noires." He also represented the band in the blue as more refrangible than F, and the one in the green as near F. In Dr. Huggins' instrument the spectrum appears differently. He

* This List is reprinted in Schellen's *Spectrum Analysis*.

finds the spectrum of *Uranus* continuous, no part being wanting so far as the feebleness of its light permits it to be traced, which is from about C to about G. The absorption taking place at *Uranus* shows itself in six strong lines. One of these, the most refrangible, appeared to be coincident with the line F of hydrogen, with which line (in the spectrum obtained from rarefied hydrogen, rendered luminous by the induction spark) it was directly compared. The positions of this and four other lines were also obtained by micrometrical measures. There is no strong line in the spectrum of *Uranus* in the positions of the strongest lines of air, namely, the double line of nitrogen. There are no absorption bands in the position of the line of sodium, or in that of any line of carbonic acid gass.

Dr. Huggins has also examined spectroscopically the light of Comet I. 1871, discovered by Dr. Winnecke, and of Encke's Comet. Both comets gave a spectrum of three bright bands, agreeeing in position with the principal bands of the spectrum of carbon, and similar to the spectra of former comets examined by Dr. Huggins.

The list of Minor Planets has been increased by five since the last Annual Report. The total number at the present time is *one hundred and seventeen.* The new members of the group are :—

1. *Amalthœa* (113), discovered on 1871, March 12, by Dr. R. Luther, at Bilk, near Dusseldorf.
2. *Cassandra* (114), discovered on July 24, by Dr. C. H. F. Peters, at Hamilton College, Clinton, New York.
3. (115), discovered on August 6, by Mr. Watson, at Ann Arbor, Michigan.
4. (116), discovered on September 8, by Dr. Peters, at Hamilton College, Clinton. This planet was independently discovered by Dr. R. Luther, on September 14.
5. *Lomia* (117), discovered on September 12, by M. Borelly, at Marseilles.

Six comets have been visible during the past year. Two of them, Encke's and Tuttle's, were expected to return to perihelion in 1871, but the remaining four appear never to have been observed before.

1. Comet I. 1871, discovered on April 7, by Dr. Winnecke, at Carlsrushe.
2. Comet II. 1871, discovered on June 14, by M. Tempel, at Milan.
3. Comet III. 1871 (Periodic Comet of Encke), first observed on October 4, by Dr. Dunér, at Lund. This Comet was first seen in England on October 8, by Mr. Hind.
4. Comet IV. 1871 (Periodic Comet of Tuttle), first observed on October 12, by M. Borelly, at Marseilles. Dr. Winnecke detected it on October 14.
5. Comet V. 1871, discovered on November 3, by M. Tempel, at Milan.
6. Comet VI. 1871, discovered on December 29, by M. Tempel, at Milan.

Encke's comet has been examined with large telescopes. At first it was a round faint nebulosity, but by the beginning of November the remarkable fan-like form which has distinguished this appearance of the comet was well marked. A minute stellar nucleus was situated at the eastern point of the fan. On the other side, towards the Sun, which the comet was approaching, the cometary matter was spread out until it was lost to view from faintness. During November the cometary matter on the side from the Sun seemed arrested a short distance behind the apex of the fan where its boundary was seen as a right line perpendicular to the longer axis of the fan-like form. Early in December a faint beam was seen to be projected from this side forming a true tail.

The Report next referred to the operations for ascertaining the variation of gravity in Western Russia, as detailed by M. Sawitsch, the publication of Mr. Williams's Catalogue of comets observed in China, Dr. Gould's observations of the magnitudes of stars in the southern hemisphere, and the progress of M. Delaunay's Lunar Tables.

The observations with the water telescope at Greenwich were mentioned—the object of which was to ascertain whether the constant of aberration would be altered by the light passing through a refracting medium. Professor Klinkerfues found such a result experimentally, but as the latitude of Greenwich, with this instrument, from γ Draconis, is found to be identical in spring and autumn, when aberration is greatest, whereas the difference, according to Klinkerfues, should be $30''$, his conclusions are not supported by the result.

The scintillation of the stars by Professor Respighi of Rome, Mr. Proctor's important communications on the distribution of the fixed stars in space, and the motion of matter projected from the sun; Messrs. De la Rue, Stewart and Löwey on the laws of the frequency of sunspots; the supposed changes in the Great Nebula surrounding η Argus; Mr. Hind's list of total eclipses of the sun up to 1890; the proposed correction of Tables of Jupiter's satellites; M. Nyren's determination of the constant of precession; Professor Trettenero's catalogue of stars; the Pulkowa observations; the chronographic determinations of the differences of longitude between Cambridge, U.S. and San Francisco, the Righi-kulm, Neuchatel, and Zurich, Naples, and Rome; the preparations for the transit of Venus; the great Melbourne telescope, and Sir J. Herschel's history of double stars, were among the other subjects mentioned in the Report, to which, however, when published, we must refer our readers for further details, as the space at our disposal is necessarily limited.

We may, however, mention that the longitude of San Francisco, as determined in four ways, viz., directly, and with two intermediate stations, differently combined, agreed within three hundredths of a second of time, and that the time occupied in transmission of the signals over 7,200 miles was eight tenths of a second.

The President's Address.

Mr. Lassell said that, as already stated, the gold medal had been awarded to Sig. Schiaparelli for his researches on the connection between the orbits of comets and meteors. It was much to be regretted that the recipient could not be present, being detained by his work at home. He (the President) would notice first, that the medallist originally became known as the discoverer of the minor planet Hesperia, in 1861; his account of which showed that he possessed both modesty and practical skill. In 1864, he communicated to the *Astronomische Nachrichten* a mathematical paper on the orbits of bodies moving freely in space, which was elegant, and probably original. In 1866, the immediate subject of the address was broached by Schiaparelli in a series of letters to Secchi. He began with the August meteors, and showed that a large number of these had a common radiant point, and that these were all of a fine yellow colour. Others of different tints were less constant in the direction from which they started. He suggested that these meteors travelled in rings round the sun, and that the earth's orbit traversed these paths, and he propounded the enquiry how such masses of cosmical matter came to be accumulated in such places. He considered both planetary and cometic bodies, the latter having such extraordinary length of orbit that they seem as if picked up by the sun. Such bodies might become visible, either by the sun crossing their paths, or travelling parallel to them. In his second letter to Secchi, he illustrated his reasoning by a series of diagrams. He stated that celestial matter might be divided into fixed stars, collections of stars (resolvable nebula) and comets, which were cloudy bodies or dust clouds—a stream of this sort crossing the orbit of a planet would take the form of a cylinder, and, when close, might break up. Meteors were formerly thought to be connected with the earth, but should now be looked upon as of the same class as stars. The elements found in aerolites were some of those in the earth. In another paper sent to the *Astronomische Nachrichten,* Sig. Schiaparelli refers to his letters on the analogy between comets and meteors, to which he is disposed to attach great importance; and assuming the August meteors to move in a curve, seen in section, he gives the elements of such an orbit, and

compares them with the elements of Comet III, 1862, as calculated by Oppolzer, and points out the remarkable coincidence between them. The period of the August meteors is somewhat doubtful, but Schiaparelli puts it at 105 years. He then took up the subject of the orbit of the November meteors, and adopting γ Leonis as the radiant point, and the other data from the display of 1866, finds the elements nearly coincident with those of the orbit of Comet I, 1866. We now know γ Leonis is not exactly the radiant point of the November meteors; and if the proper correction be made by using the point deduced from Alexander Herschel's observations, the difference between the two orbits disappears. The hypothesis, thus singularly confirmed in these two instances, must command a high degree of probability, and is a true advancement of Astronomical science, which, doubtless, Schiaparelli had not ventured to anticipate. His success should lead to arrangements for the systematic observation of these phenomena. The President then handed the medal to Col. Strange, requesting him to transmit it to Sig. Schiaparelli with the best wishes of the Society for a success in the future equal to that which he had already achieved, and that such might be continued during a long and prosperous life.

It was moved by Mr. Vignolles, seconded by Mr. Perigal, and resolved:

That the Report be received, printed, with the President's Address, and circulated in the usual manner.

Mr. C. V. Walker and Admiral Ommaney having been appointed Scrutineers, the ballot for the election of Officers took place. The result was as follows:

President:

Arthur Cayley, Esq., M.A., F.R.S., *Sadlerian Professor of Geometry, Cambridge.*

Vice-Presidents:

J. C. Adams, Esq., M.A., F.R.S., *Lowndean Professor of Astronomy, Cambridge.*

Warren De la Rue, Esq., D.C.L., F.R.S.

William Huggins, Esq., D.C.L., LL.D., F.R.S.

William Lassell, Esq., F.R.S.

Treasurer:

Samuel Charles Whitbread, Esq., F.R.S.

Secretaries:

Edwin Dunkin, Esq.

Richard A. Proctor, Esq., B.A.

Foreign Secretary:

Lieut.-Col. Alexander Strange, F.R.S.

Council:

G. B. Airy, Esq., C.B., LL.D., F.R.S., &c., *Astronomer Royal.*
John Browning, Esq,
J. Buckingham, Esq.
Thos. W. Burr, Esq.
W. H. Mahony Christie, Esq., M.A.
E. B. Denison, Esq., D.C.L., Q.C.
George Knott, Esq.
J. Norman Lockyer, Esq., F.R.S.
Rev. Robert Main, M.A., F.R.S. *Radcliffe Observer.*
Captain William Noble.
Rev. Charles Pritchard, M.A., F.R.S., *Savilian Professor of Astronomy, Oxford.*
A. Cowper Ranyard, Esq., M.A.

Upon the motion of Dr. Pinches, seconded by Admiral Ommaney, the thanks of the Society were voted to the retiring officers, and the Meeting adjourned.

Erratum in last Report. The foot-note at page 31 was omitted. It is—* Query *coronal.* The word *chromospheric* was used at the Meeting, but reference to Col. Tennant's letter shows that the radiation spoken of applied to the corona.

AURORA BOREALIS.

There was a magnificent display of aurora borealis on Sunday night, Feb. 4. It began about 6·30, and lasted for several hours. There was an intense red light passing across the heavens, through the constellation of the Great Bear, over the Pole Star, and so on, through the centre of Cassiopeia, and the most perfect cupola of light rays, culminating in Auriga, rather below Capella. Towards the close beautiful red rays shot through the region of Polaris to Auriga. It was observed at Constantinople and Alexandria.

AURORA OF FEB. 4, AT FLORENCE.

Professor Donati, in the *Gazette d'Italia,* of the 6th of February, writes that any description would only give a faint idea of the reality. . . . such was the abundance and beauty of the perpetual variations of aspect presented by the stupendous phenomenon. It began at 6 o'clock, with a *blood red* light on the N.E. horizon, which gradually spread, and rose higher. At 6h. 20m. it embraced an arch of 160 deg. on the horizon, and rose as far as the pole. . . . From that time till the end, so many were the rays at one time red, at another greenish, and at another yellowish, which rapidly changed their places, that a full description would be very complicated. At 9 h. a large red luminous arch extended from S.E. to S.W., having an elevation of 45° at the south. It might rather have been termed an aurora australis than borealis. . . . This arch disappeared at 9½ h.; at 11 h. 40 m. the phenomenon was quite ended.

The magnetic needle, which had manifested perturbations ever since the morning, during the time of the aurora became quite wild (*affato impazzito*), and it was impossible to determine its position, since it had altogether left the graduated scale by which its direction is noted.

Great disturbances were manifested on the telegraph lines to Livorno, Bologna, and Turin, the electric currents continually changing in intensity and direction; but these changes were not contemporaneous nor analogous in the different lines. . . . The aurora is known to have been observed throughout all Italy, and as far as Malta. . . . I was fortunate enough to be enabled to analyse the spectrum of the auroral light . . . continuous from the red to the violet, but faint; nevertheless, it had a vivid light line in the green, which my observations showed to correspond with the middle of the space comprised between the lines *b*, *D*, of the solar spectrum. At intervals I also perceived a line in the red corresponding to about the line C of the sun; and one in the blue, corresponding to the solar line F; but their fleeting character prevented my determining their precise position.

The Professor then mentions some observations on the 4th and 5th which he made, but under unfavourable circumstances, on the disc of the sun, with a spectroscope applied to a small telescope. On the latter morning he noticed that the stratum of hydrogen was especially very high in the direction of the earth's equator. The spots on the sun, he observes, are at present very numerous; to-day we have counted 96. I made these observations on the solar disc as well as I could under the actual state of our observatory, which at this moment is neither in Florence, nor at Arcetic, but in a transitional state. . . . Much has yet to be done in this department of Natural Philosophy. . . . What, for example, is the bright green line which has been seen in the auroral spectrum? . . . It does not appear to correspond with any of the lines that we can produce with any terrestrial substances. It is held (and for many good reasons) that the auroral lights arise from weak and continuous electric discharges. But if the light of the aurora is electric, it should have the same lines which are observed whenever with our laboratory apparatus we cause the electric light to pass through the air; but it is not so; and, in fact, the green line of the aurora has never even been seen in our experiments. Anticipating the hereafter clearing up by science and art of this and many other mysteries, Donati observes that, in order to uninterrupted advance, much intellectual strength is needed, and likewise much material strength, since now progress in Physics cannot be made if the most elevated genius is without the aid of apparatus, perfect, exquisite, and always very costly.

The Contessa Baldelli, observing that "Nothing could describe the loveliness and grandeur of the sight," says: "Donati does not appear to have seen an extraordinary appearance. Baldelli and myself (and I hear another person of my acquaintance also) saw, just about Lepus, below Orion, several curved and parallel waves of *very* bright white light moved towards each other; met, broke; met once more; separated again in different forms; flashed brighter, just into what had the appearance of white flame; darted about like white lightning, and ended by making a crown of irregular rays (quite fiery), some very long; and then, after a second or two (the whole appearance lasting not quite two minutes, I should think) disappeared all at once. I think the time was 8·30 P.M."

AURORA OF FEB. 4, AT FLORENCE.

Yesterday, we passed from one spectacle to another. The heavens, too, willed to celebrate a festival, and to salute, with their Bengal lights, the resuscitated carnival; presenting us with the most brilliant, the most splendid aurora that has been ever seen.

The people, who were quietly returning from the Corso to dinner,

were at first surprised at the sight of that unwonted reddish colour, which looked like the reflection of a fire, and then presented the appearance of clouds, reddened by a gradual sunset. But as the air became darker, those transparent clouds began to dilate themselves, spreading over the heavens like an immense purple sheet, perforated here and there, or like a thin veil, through which the stars, tinged with red, were seen to twinkle. And then the people, unmindful of dinner, stopped curiously in the streets, formed groups in the piazza, and with eyes turned upwards, and endless exclamations of wonder, followed the singular phenomenon in all its fantastic course.

No one remembers in our climes anything similar ; no one can speak of having seen an aurora which lasted from half-past five or six o'clock till towards midnight.

It was an imposing and a grand sight, at once awe-inspiring and fascinating. Everyone could have wished to possess such knowledge of astronomy as to account for the different phases, the capricious undulations, the wanderings, the transformations of the ætherial mass waving in the atmosphere, that drifted as though impelled by the night breeze, and in its movement took ever new forms, lengthened itself in luminous bands, and arranged itself like so many rays converging to a centre.

Perhaps the finest moment was between half-past six and seven, when on the north, behind the Mount of Fiesole, was to be seen clear and most distinct the limpid and tranquil light of the aurora, with a lustre so white as to make one fancy that the sun was there just on the point of rising.

The mountain all round received the quiet splendours of the nascent dawn ; the little hills were illumined, standing out distinctly, and not as before obscure in the horizon. Nevertheless, there was something in that distant light, something that convinced one that it was the reflection of an aurora rather than a real day-spring.

The mountain appeared somewhat depressed ; the light did not send forth those gradations of colour which announce the rapid approach of day; it remained there, motionless, limpid, and cold, as though our eyes also were struck by the reflection of eternal and immovable polar ice. And all round it there was, as it were, a garland of little clouds, which reflected and sent back the brightness, and from thence parted off long luminous bands suffused with mist, which, as they approached the fiery mass on the other part of the heavens, gradually acquired a deeper tint till they assumed altogether the colour of fire, and were lost in that aerial torrent which resembled lava poured forth from some celestial volcano, and kept by a mysterious force suspended and waving in the air.

The crowd of curious persons did not decrease in any quarter of the city, for the spectacle altered every moment, assuming new and fantastic shapes. For instance, about nine o'clock, on the Lungarno the red curtain was seen rent in some places, and then, in place of the blue vault of heaven, there appeared there what resembled three or four tails of comets, curiously twisted and knotted together like a gigantic white plume.

These tails then suddenly changed colour and became empurpled, like thousands of the plumes of carabineers on a gala day; and on all sides there were sparkling bands and luminous paths like ribbons, and parallel lines which were lost as they became curved on the vault of the heavens, and gave the idea of an aerial double line of railroad, and rays and beams, and glowing mists, and fresh rents, and fresh forms, and a crowding together, and a dissolution—in a word, a spectacle most marvellous and of infinite delight.

I have thus recalled the passing impressions of the most remarkable

evening which we, whom Nature rarely favours with extraordinary sights have ever seen. But science is entitled to give her account. . . . . (The writer goes on to refer to Professor Donati's letter on the aurora, and then observes.) When the theatres were closed last night, and everyone returning home was gazing upon the horizon, the aurora was quite over, and in one of the places where it had been most vivid, there were to be seen some clouds of curious forms, detached from each other, and motionless in the sky, like the tents of an encampment after a whole day's battle. Editorial article in the *Gazzetta d'Italia*, Florence, Feb. 6, 1872.

THE TOTAL SOLAR ECLIPSE OF 1871.

LETTER FROM M. JANSSEN TO MR. LASSELL, P.R.A.S.
(Translation.)

I shall have the honour of addressing to the Royal Astronomical Society a detailed account of my Observations of the Eclipse; but I take the opportunity of the post leaving to inform you of the principal results obtained.

Without going into a discussion, which will form part of my report, I will first say, that the magnificent corona observed at Sholoor was exhibited under such an aspect that it would appear to me impossible to admit that the cause of the phenomena was of the order of either diffraction, reflection from the lunar surface, or even of simple illumination of the terrestrial atmosphere.

The reasons which militate in favour of an objective, circumsolar cause acquire invincible force when we examine the luminous elements of the phenomena. Indeed, the spectrum of the corona appeared in my telescope not continuous, as it had been described up to this time, but remarkably complex. I have found in it:—

Bright lines which, although faint, are those of hydrogen gas, which constitutes the principal element of the prominences and chromosphere. The bright green line, which has already been noticed in 1869 and 1870, and some other fainter lines, also some dark lines of the ordinary solar spectrum, especially that of Sodium (D). These are very difficult to perceive.

These facts prove the existence of matter in the vicinity of the sun, matter which shows itself in total eclipses by the phenomena of emission, absorption, and polarization.

But the discussion of these facts leads us much further still.

Besides the cosmical matter, independent of the sun, which must exist in the neighbourhood of this star, the observations demonstrate the existence of an extended and excessively rare atmosphere, with a basis of hydrogen, stretching itself out beyond the chromosphere and the prominences, and feeding itself with the same matter as these bodies—matter shot out with great violence from the photosphere, as we see daily.

The rarity of this atmosphere must be excessive; its existence, therefore, is not discordant with the observations of some passages of comets near the sun.

Neilgherry, Sholoor: December 19, 1781.

THE GREAT MELBOURNE TELESCOPE.

We find by the report of the board of visitors to the Observatory of Victoria that the great telescope is working well. Mirror A, which was so much tarnished, has been repolished, and its "performance has been

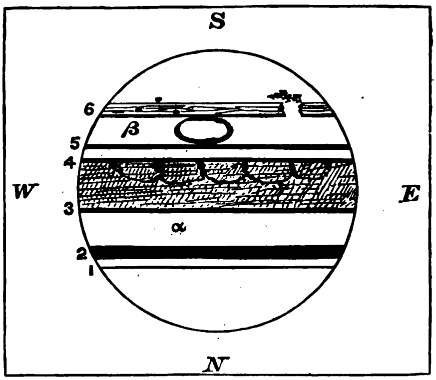
found to be working very satisfactorily." It is also noticed that the cause of the defect in mirror B has been discovered, and that a remedy can be found for it. Further experience of the telescope has much enhanced the observers' opinion of it.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

JUPITER.



From 6 p.m. to midnight on the 2nd of February, the sky was cloudless; and, though the definition was never good, a set of five careful drawings was obtained here.

I proceed to describe these in the order in which they were taken :—

No. 1, at 7 p.m. Band No. 3 is as broad and dark as No. 2. No. 4 is faint, and has dark spots under it.

The new band (between Nos. 2 and 3) is faintly seen. *All the bands are faint.*

The shading about the N. pole is much darker than that about the opposite pole. It is also more extensive, but no bands are seen in it.

Not far from the E. edge No. 5 is seen to touch No 4 ; it then slopes to the S.W. at an angle of some 30°, and then bifurcates ; one portion runs to the west, parallel to No. 4, and the other continues in the original direction, until it reaches the latitude of No. 6. The sloping branch is a broad streak; the other is faint, and has two faint dark spots upon it. This sloping band it well shown in Mr. Birmingham's neat sketch. To the east, No. 6 is seen as a dark very broad cloudlike mass.

No. 2 at 6h. 30m. p.m.

No. 2 is now broader and darker than 3 or 4.

No. 6 is the broadest, and is as dark as No. 2. Its width is about 2″.

The brightest zone is that lying between No. 2 and the south edge of the shading about the N. pole.

The zone between 2 and 3 is dusky, and the new band can be traced along it from edge to edge of the disc.

A narrow band is well seen just south of No. 6.

The sloping portion of No. 5 is still seen; it falls down quite to No. 4; it reappears towards the east as a narrow band parallel to No. 4.

No. 6 is the finest streak visible. It is connected with No. 5 by two faint cloudy patches.

In the central zone are seen the usual dark spots under No. 4, and the usual cloudy markings in some portions. Along the central line runs a narrow band; before reaching the eastern limb it bends down to No. 3; the space between this central band and No. 3 is free from colour and markings.

The other parts of the great equatorial zone are reddish, but the colour is best seen in the northern parts.

No. 3, at 9h. 30m. p.m.

The fine southern band No. 6 is now passing away, growing gradually narrower towards its eastern extremity.

No. 5 is visible only near the E. limb.

Under No. 4 two bright rectangular spaces are now seen, each is about 4″ in length; a similar one lies on No. 3, below and between those on No. 4.

The latter quite cuts through the band.

The new band between Nos. 2 and 3 is seen from limb to limb.

No. 4, at 10h. 30m.

No. 2 is now the finest streak on the disc.

Three bright rectangular spaces lie on No. 3, and five or six similar spaces are seen under No. 4.

No. 5 is remarkably developed; it is very broad near the E. and W. limbs of the planet, but its middle portion is narrower.

No. 6 is seen near the western edge of the disc; it then turns south-eastwards and runs gradually up to the shading about the southern pole; it is again seen in the original parallel near the E. edge of the disc.

The zone between Nos. 2 and 3 is very dusky, but has one large bright space near the centre.

No. 5, at 11h. 45m.

The shading about the *south pole* is now darker than that about the opposite pole. Its northern edge has a bright square gap cut out of it, greatly resembling that so often seen in 1869.

No. 6 is faint, and a still fainter streak is seen to the south of it.

No. 5 is broader and darker and varies considerably in width and darkness in different parts.

It is now quite impossible to distinguish clearly the boundary between the central zone and the zone between bands 2 and 3, so nearly identical are they in appearance, *i.e.*, band No. 3 is perhaps quite invisible; the shady region, therefore, extends from 2 to 4 and gives the disc a very strange appearance. A row of bright spaces lies under No. 4, one is also seen where band No. 3 used to be, and not far from the west edge of the disc.

No trace of a reddish hue can now be seen in the central zone.

Mr. E. Crossley's Observatory, Park Road, Halifax: Feb. 5, 1872.

JOSEPH GLEDHILL, F.G.S., &c.

THE TAIL OF ENCKE'S COMET AND THE SECONDARY LIGHT OF VENUS.

Sir,—In reference to Mr. Knobel's letter in your last impression on Encke's comet, having been hitherto supposed to be destitute of a true tail opposite to the sun, may I direct his attention to the following observations made at the appearance of 1848.

Professor W. C. Bond, of Cambridge, U.S., made the following notes (amongst others), which are printed in the *Monthly Notices*, Vol. IX., p. 107:

"October 27: a faint ray of light is now seen directed from the sun. November 3: the Comet shows a tail of one or two degrees, directed *from* the sun; with the same appearance on the opposite as in October" (*i.e.*, a fan-shaped brush of light on the side *towards* the sun).

Dr. Julius Schmidt, observing at Bonn on the same occasion, speaks also of seeing traces of a tail on the 22nd of October and 9th of November. *Astronomische Nachrichten*, Vol. XXVIII., p. 186. The same well-known and now veteran astronomer made also a valuable series of observations of Encke's Comet at the appearance in 1868, and says: (*Astronomische Nachrichten*, Vol. LXXII., p. 323) "that from August 20 to 29 the tail was quite narrow, very faint, straight, and in the normal position" (*i.e.*, opposite to the sun).

In reference to my own letter on Dr. Winnecke's observation of the secondary light of Venus, at her last inferior conjunction, I beg to inform you that I have been favoured by a letter from Mr. C. Leeson Prince, of Uckfield, in which he calls my attention to some observations of his own, printed in the *Monthly Notices*, Vol. XXIV., p. 25. It is there recorded that on the 25th of September, in the year 1863, Mr. Prince saw the dark body of Venus in the day-time; also on the 26th and 28th (the latter being the day of inferior conjunction); and that on the 25th, 27th, and 30th, he saw a phosphorescent flitting of light all round the edge of the disc. Dr. Winnecke appears therefore to have been in error in supposing that Andreas Mayer had been the only previous observer of the secondary light of Venus in the day-time.

I remain, sir, yours faithfully,

Blackheath; January 8, 1872. W. T. LYNN.

EPSILON LYRÆ.

Sir,—I have read with very great pleasure and interest the able letters of Mr. Grover and your esteemed correspondent, Mr. Squire, referring to the minute stars near Epsilon Lyræ. It would appear that neither of these observers have yet picked up the new pair, No. 4; I am rather surprised at this, as (unless they have since decreased in brilliancy) they ought to be seen pretty readily. This pair is not situate *between* the quadruple and the triangular figure preceding them, but just to the north of the northernmost of pair No. 3. The new pair forms almost an exact fac-simile of the "Debilissima," being at the same angle and distance apart, but are somewhat brighter.

As this subject is an interesting one, and both Mr. Grover and Mr. Squire have referred to evidences of *variability* in some of these faint objects, it may not be uninteresting to your correspondents to know that there is also distinct evidence of variability on the lustre of the N star of pair No. 3. I call these pairs numerically only because no better method of recognising them is yet given. In January, 1871, I found the order of brilliancy of these objects to be, as I stated in my letter of February, viz.:

Pair... ...	No. 1.	No. 2.	No. 3.	No. 4.
N. star ...	6	×	2	3
S. star ...	5	7	×	4

the 9th magnitude star following, being called 1. At this time, the northernmost of pair No. 3 was a very easy object, being nearly as bright as 1. The new pair No. 4, just to the north of it, were far more difficult to see, being nearly 1 magnitude less than their neighbour. In September, 1871, I was surprised to observe that considerable changes had taken place. Pair No. 4 were seen pretty easily, but the one to the south of them (being the N. of pair 3), instead of being, as usual, *brighter* than pair No. 4, was much *less bright* than those, and could only be *glimpsed with averted vision.* A comparison of the brilliancy of pair 4, with the 9th magnitude star following, showed them to be of the usual brightness, thus proving that the N. of pair 3 had really decreased considerably in lustre. I should estimate the decrease to amount to nearly 2 m. These facts, combined with the almost certain variability of one of the "Debilissima" lend additional interest to the group.

A reference to my note book informs me that I first noticed the great increase in the lustre of the N. of pair 3, on May 25, 1870, not having remarked it previously, although the object had often been under observation. Its large decrease was first noticed on September 25, 1871; whether it had attained a minimum within this period I cannot, of course, say for certain. I trust both Mr. Grover and Mr. Squire will kindly favour us with the result of their further observations of the group.

May I take the opportunity of respectfully thanking your talented contributor, Mr. Gledhill, for his courteous reply to my query on Jupiter. As no other observer seems to have recorded anything on the date in question, we must conclude that the weather was unfavourable in most localities. I regret this, as the observation would have been valuable, if corroborated by others. I remain, yours faithfully,

Hoxton Street, N. ALBERT P. HOLDEN.

January 6, 1872.

CUI BONO.

Sir,—Presuming your *Register* is published for the edification of the ignorant as well as the amusement of the learned, I may be pardoned in making exception to "A Subscriber's" comparative analysis of Mr. Waite's and Mrs. Nickleby's respective form of expressions.

For my own part, I am better able to appreciate Mr. Waite's meaning when he compares the size of a possible planet to "an ordinary sized marble," than I am to understand the capabilities of Mr. Abbott's telescopes, showing "a field of $1° \; 7' \; 42''$," and, I am ashamed to confess, that I have more faith in the record of a fact that happened between the years A.D. 1860 and 1863, than in the theory that Mr. Williams supports, that a conjunction of the five principal planets occurred during the reign of Chuen Kuh, on the 29th Sept., B.C. 2449.

Taking much interest in the little I am able to understand in your publication, I trust, in opposition to "A Subscriber's" title, to demand that such records referred to should be excised, that you will be pleased at times to lower your ideas and communications to the level of—

January 10, 1872. Yours obediently, R. E. J.

DYNAMETER OR DYNAMOMETER.

Sir,—I know not if it be worth while to discuss further the "Dynamometer" question. As rightly observed by yourself, "Dynameter" (honour all the same to Jesse Ramsden) cannot pass muster if judged by ordinary rules of composition, which is a pity, for it is a handier word than the other.

As Mr. Williams shows, it is not so much a question of spelling as usage; and whilst we have so much that is arbitrary and merely conventional in our language, one is disposed to attach the less importance to any one particular instance.

I am not aware, however, if you have noticed that neither is "dynamometer" formed according to strict analogy. Suppose we had to coin a word fresh for our purpose. With the conjunctive vowel *o* would it not properly be *Dynami-o-meter* (dynamiometer)? This would accord with *Physi-o-logy* and *Ichthy-o-saurus*. Or, without the conjunction vowel, we might have *Dynamimeter*. "Dynamometer" may, indeed, be supposed to be made up of the conjunction *o*, blended with the long *o* of the *Attic* genitive; thus, *Dynameōmeter*, and the final process (perhaps a venial license) would give us the contracted (?) form in which the word is now used. Ordinary pronunciation is probably against this theory, the *o* being sounded as in barometer. I don't see how it can be accounted for. It was not really required at all, and ought not to have displaced the *i*. Anyhow, there it is, and the French, I think, use the same word, dynamomêtre. Yours, &c., G. J. W.

Dear Sir,—I must trouble you to correct a serious printer's error in my letter in your January number. In page 17, line 40, the word *dynameter* should be *dynamometer*, as you will find on referring to my MS.

Your note appended to my letter requires a few lines in reply. I by no means admit that "dynameter means nothing at all." *Dyna* does not, it is true, contain as many syllables as δυναμις; but whether the retrenchment of a syllable by the ordinary and perfectly legitimate operation of syncope renders the word meaningless, or whether the introduction of a wrong syllable (by which the word is not only unnecessarily lengthened but made less euphonious) converts it into an intelligible expression, I leave to your readers to decide. In my opinion a better or a neater word than *dynameter* could not have been framed; and I venture to contend, with great submission, that there is no foundation for your statement that *dynamometer* is the only admissible one. In the case you have suggested it is quite clear that "chrometer" would never have sufficed to describe an instrument for measuring time, because it would not have reasonably resembled its first derivative. "The Comprehensive Dictionary" gives the verb μετρεω as one of the derivatives of dynameter, and until satisfied that that authority is untrustworthy I shall be disposed to rely upon it. Numerous similar instances occur in the same work; telescope, for example, is said, and properly said, to be derived from τηλε, or τηλος and σκοπεω. The fact that the Greeks observed certain rules in the formation of their compounds in no way affects the present question, seeing that the word dynameter was not invented by the Greeks but by the English. Yours faithfully,

Upper Holloway: GEO. WILLIAMS.
Jan. 12, 1872.

[We owe some apology to our readers for giving so much of our space for a subject not properly astronomical. We should not have done so except that we felt the importance of once for all protesting against the crude and unscholarlike way in which scientific words are so frequently formed. We never doubted that the instrument in question had been called a dynameter. What we meant was that it should never have been so named, and now that the word was more commonly spoken of as a dynamometer; that that form of the word, being correctly compounded, was preferable to the curtailed form.

There is no rule of syncope known to the Greeks by which δυναμομετρον could be contracted into δυναμετρον. There is no sense in the word δυνη or δυνα, and so none in δυναμετρον. Mr. Williams objects to our com-

paring the word with chronometer—chrometer. Be it so. Take the word anemometer, and we have a word letter for letter similar to dynamometer. If his "ordinary" (?) rule for syncopation be corrrct, and two instruments of measure were required, we might say "anemeter," which would really give no sense at all, any more than dynameter does. The most learned Greek scholar could only *guess* at what either word meant.

With respect to Greek compounds, I refer our correspondent to Dr. Jelf's Greek Grammar, § 346, Obser. 1. b. How much ignorance existed with respect to this matter was shown by Professor Shillito when the word telegram was first coined. If any of the words spoken of were derived from the verb, they would have a verbal form. Thus, telegram would be telegrapheme ; dynamometer would be dynamometrem (*μετρημα*) or dynamometrete (*μετρητης*).

If Englishmen derive scientific words from Greek, they ought to conform to the Greek usage of composition. If this were done, our language would not be deformed by such monstrosities as pannus corium, and half the botanical and other scientific words which are a disgrace to us, among which I must class dynameter.

Mr. Walker's objection "solvitur ambulando," as it were, for there is a Greek word extant, *δυναμοδυναμις* (a biquadratic root) to guide us, so that there need be no hesitation in using dynamometer.

SPECTRUM ANALYSIS.

No book has been published in England more likely to popularise the very interesting subject of Spectrum Analysis, than the Miss Lassell's admirable translation of Dr. H. Scheller's valuable work, published by Messrs. Longmans, Green and Co.

The book was recommended to these ladies by Dr. Huggins, as the best elementary book upon the spectroscope; and, fortunately, they were so interested that they determined to publish an English Edition. All who wish to commence the study of the spectroscope, which is playing so prominent a part in Science, should read this volume, which gives a most lucid and complete explanation of the instruments which have been used for the purpose, and of the discoveries made up to the present time. In a subject so comparatively new, of course some of the theories are to be received with caution, and much that is now thought to be proved, will doubtless have to be reconsidered. With this proviso, we can thoroughly recommend the book, which is sumptuously got up and profusely illustrated. Of course, some of the most interesting pictures are those of the various views of the sun at the total eclipses, and the solar prominences which have of late years attracted such attention.

We have no doubt that the work will have the large circulation which it well deserves.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MARCH, 1872.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight.		Objects to be observed.
	°	′	
13 ...	124	32·1 ...	Hagecius, Picard, Reichenbach.
14 ...	113	8·4 ...	Democritus, Sartner, Fermat.
15 ...	102	1·2 ...	Clairaut, Cuvier, Descartes.
16 ...	91	5·7 ...	Eudoxus, Aristoteles, Alexander (*a*).
17* ...	80	16·1 ...	Mt. Huygens, Kirch, La Caille.

18	...	69 27·1	...	Gambart, Heinsius, Hesiod.
19	...	58 33·5	...	Kies, Lubiniezky, Stadius.
20	...	47 30·7	...	La Hire, Pytheas, Gay Lussac.
21	...	36 15·0	...	Rosh Gassendi, its interior.
22	...	24 44·0	...	Piazzi, Grimaldi, Pythagoras.
23	...	12 56·5	...	La grange, objects near E. limb.

For additional objects consult the lists for November and January.

SEASON.—Winter in the northern hemisphere. The solstice occurred on the 7.

Between new moon and the 13th the following objects constituting a zone from north to south may be observed as they come into sunlight. They with the previous zones (see January and February) have been arranged to assist the observer in picking up objects during the progress of the terminator, and will help in approximately forming zones of latitude, if arranged somewhat as follows from each zone.

Mare Humboldtianum, Endymion, etc.; Plutarch, Oriani, Eimmart, etc.

Webb's map will greatly assist in effecting these arrangements. Advantage should be taken when the moon is between Perigee and Apogee for observing these objects,

Thales, Strabo, De la Rue, Endymion, Struve, Eimmart, Alhazen, Hansen, Maclaurin, Palitzsch, Hase, Vega.

* PLATO.—On the 17th, the terminator will be near Plato. On the 18th of January, 1872, the phase of illumination (terminator through the W. part of Plato) was nearly the same as on March 10 and May 8, 1870. On May 8, 1870. ⊙—☊ = 295° 31′, on March 17, 1872, ⊙—☊ = 280° 34′. The seasons being so much alike in both cases, it is probable that on March 17, 1872, the western edge of Plato will be just in sunlight. (*a*) See February 25, 1871.

Errata.

Page 45, February 12, for *Sautbech* read *Santbech*, February 18, for *Delue* read *Deluc*. In last line but two, for *Pitavius* read *Petavius*. Page 46, line 2, for *Lapeycourse* read *Lapeyrouse*.

February 14 and 15. The objects entered against those days in the last list were *not* in sun-light, but were well illuminated on the following days. This was occasioned by the great eastern libration. The moon being between Perigee and Apogee, these objects were beyond the terminator, as referred to the phases. At midnight, on the 15th, six hours before First Quarter, the longitude of terminator was quoted as 8°4 west, at 6h. it had scarcely advanced beyond 15°.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, Midnight			60°N.		0°		60° S.
				SUNSET.			
1872. Feb.	1	...	+ 3°5	...	+ 6°1	...	+ 8°8
	2	...	— 8·7	...	— 6·1	...	— 3·4
	3	...	20·9	...	18·2	...	15·6
	4	...	33·1	...	30·4	...	27·8
	5	...	—45·3	...	—42·6	...	—39·9
				SUNRISE.			
	11	...	+66·8	...	+64·1	...	+61·5
	12	...	54·6	...	51·9	...	49·3
	13	...	42·4	...	39·7	...	37·1
	14	...	30·2	...	27·5	...	24·9

15	— 18·0	15·3	12·7
16	+ 5·8	+ 3·2	+ 0·5
—			
17	— 6·4	— 9·0	—11·6
18	18·6	21·2	23·8
19	30·8	33·4	36·0
20	43·0	45·5	48·1
21	55·1	57·7	60·3
22	67·3	69·9	72·4
23	—79·5	—82·0	—84·6
—			
		Sunset.	
25	+71·2	+73·7	+76·2
26	59·0	61·5	64·0
27	46·9	49·4	51·8
28	34·7	37·2	39·6
29	22·6	25·0	27·4
30	+10·4	12·8	15·2
31	— 1·8	+ 0·6	+ 3·0

The sun's disc passes the true horizon of Linné—

On March 15 from 20h. 5m. to 21h. 7m. rising.
„ 30 „ 12h. 4m. to 13h. 6m. setting.

THE PLANETS FOR MARCH.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	22 30 13	—11 39½	4″·8	23 47·9
	15th	0 0 47	—0 60	5″·0	0 27·1
Venus ...	1st	20 40 40	—18 24	13″·0	21 58·7
	15th	21 49 22	—13 37½	12″·2	22 12·2
Jupiter ...	1st	7 27 35	+22 26	40″·4	8 47·8
	15th	7 26 16	+22 29½	39″·8	7 51·4
Saturn ...	15th	19 24 57	—21 40½	14″·4	19 55·4
Uranus ...	1st	7 59 20	+21 17	4″·2	9 19·4
	13th	7 58 9	+21 16½	4″·2	8 31·1

Mercury is favourably situated for observation at the end of the month, setting on the last day an hour and three quarters after the sun ; he comes to superior conjunction on the evening of the 10th, at 9h. 3m.

Venus rises nearer to the sun each day, the interval decreasing at the end of the month to half-an-hour.

Jupiter is still visible all night, aud very favourably situated for observation.

Uranus is well situated for observation.

ASTRONOMICAL OCCURRENCES FOR MARCH, 1872.

DATE.		Principal Occurrences. h. m.		Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m. Jupiter
Fri	1		Sidereal Time at Mean Noon, 22h. 38m. 23·10s.	1st Oc. D. 1st Ec. R.	8 28 11 45 2	8 47·8
Sat	2	7 28 16 54 18 7 17 7 18 5	☾ Moon's last quarter Occultation of B.A.C. 5831 (6) Reappearance of ditto Occultation of 39 Ophiuchi (6) Reappearance of ditto	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	5 47 6 48 8 7 9 8	8 43·6
Sun	3		Sun's Meridian Passage 12m. 1·62s. after Mean noon	1st Ec. R. 2nd Oc. D.	6 13 53 14 31	8 39·5
Mon	4	8 45 20 5	Conjunction of Venus and θ Capricorni (5m.9) E. Conjunction of Moon and Saturn 2° 58′ N.			8 35·5
Tues	5			2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	8 38 10 44 11 33 13 40	8 31·4
Wed	6	11 16	Conjunction of Moon and Venus 3° 58′ N.	4th Sh. I. 3rd Oc. D. 3rd Oc. R. 4th Sh. E. 3rd Ec. D.	7 48 8 16 11 44 12 9 12 38 12	8 27·3
Thur	7			2nd Ec. R. 1st Tr. I. 1st Sh. I. 1st Tr. E.	8 45 35 13 9 14 14 15 29	8 23·3
Fri	8	19 42	Conjunction of Moon and Mercury 3° 35′ N.	1st Oc. D. 1st Ec. R.	10 17 13 40 15	8 19·2
Sat	9	0 53	● New Moon	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	7 37 8 43 9 56 11 3	8 15·2
Sun	10	3 21	Conjunction of Moon and Mars 4° 34′ N.	3rd Sh. E. 1st Ec. R.	6 6 8 9 7	8 11·2
Mon	11					8 7·2
Tues	12			2nd Tr. I. 2nd Sh. I. 2nd Tr. E.	11 5 13 21 14 0	8 3·3
Wed	13			3rd Oc. D. 3rd Oc. R.	11 55 15 24	7 59·3
Thur	14			2nd Oc. D. 4th Oc. D. 4th Oc. R. 2nd Ec. R. 1st Tr. I.	6 10 6 46 10 56 11 21 23 15 0	7 55·3
Fri	15		Illuminated Portion of disc of Venus 0·849 ,, Mars 0·992	1st Oc. D. 1st Ec. R.	12 8 15 35 33	7 51·4

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon. —
Sat	16	14 25 8 16	☽ Moon's First Quarter Near approach of B.A.C. 1774 ($6\frac{1}{2}$)	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	9 27 16 38 11 47 12 58	5 49·1
Sun	17	 11 8 11 53	Saturn's Ring: Major Axis 36·15″ Minor Axis 14·29″ Occultation of B.A.C. 2154 ($6\frac{1}{2}$) Reappearance of ditto	3rd Sh. I. 1st Oc. D. 1st Ec. R. 3rd Sh. E.	6 33 6 36 10 4 26 10 7	6 38·7
Mon	18	12 32	Conjunction of Moon and Jupiter, 2° 18′ S. Sun's Meridian Passage, 8m. 4·28s. after Mean Noon	1st Tr. E. 1st Sh. E.	6 15 7 27	7 28·7
Tues	19	3 4	Conjunction of Moon and Uranus, 2° 46′ S.	2nd Tr. I.	13 35	8 18·3
Wed	20			3rd Oc. D.	15 40	9 7·0
Thur	21			2nd Oc. D. 2nd Ec. R.	8 39 13 57 5	9 54·4
Fri	22			1st Oc. D. 4th Tr. I.	14 0 14 16	10 40·5
Sat	23			2nd Sh. E. 1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	8 15 11 19 12 33 13 39 14 53	11 25·8
Sun	24	13 43 3 24	○ Full Moon Conjunction of Mars and Mercury, 1′ 8″ N.	1st Oc. D. 3rd Tr. E. 3rd Sh. I. 1st Ec. R. 3rd Sh. E.	8 28 9 3 10 32 11 59 50 14 6	12 10·8
						Jupiter. —
Mon	25	16 8 16 39 17 9	Near Approach of 65 Virginis (6) Occultation of 66 Virginis (6) Reappearance of ditto	1st Sh. I. 1st Tr. E. 1st Sh. E.	7 2 8 7 9 22	7 12·8
Tues	26	13 8 14 11	Occultation of 96 Virginis ($6\frac{1}{2}$) Reappearance of ditto	1st Ec. R.	6 28 39	7 9·0
Wed	27	16 30 17 13	Occultation of γ^1 Libræ (6) Reappearance of ditto			7 5·2
Thur	28			2nd Oc. D.	11 9	7 1·4
Fri	29	13 5 13 27 13 37 14 11	Occultation of 22 Ophiuchi ($6\frac{1}{2}$) Reappearance of ditto Occultation of 24 Ophiuchi ($6\frac{1}{2}$) Reappearance of ditto			6 57·7
Sat	30			2nd Sh. I. 2nd Tr. E 2nd Sh. E. 1st Tr. I. 1st Sh. I.	7 55 8 18 10 51 13 12 14 28	6 53·9
Sun	31	14 31	☾ last quarter	3rd Tr. I. 1st Oc. D. 4th Ec. D. 3rd Tr. E.	9 25 10 21 11 54 3 12 54	6 50·2

SUN.

Greenwich, Noon. 1872.		Heliographical longitude of the centre of			Heliographical latitude the sun's disc.		Angle of position of the sun's axis.
		°			°		°
Mar. 1	...	330·77	+60 δ ξ	...	−7·24	...	338·00
2	...	343·96		...	7·25	...	337·76
3	...	357·15		...	−7·25	...	337·52
4	...	10·34		...	7·25	...	337·29
5	...	23·53		...	7·25	...	337·07
6	...	36·72		...	7·24	...	336·85
7	...	49·91		...	7·24	...	336·64
8	...	63·10		...	7·23	...	336·46
9	...	76·30		...	7·22	...	336·24
10	...	89·49		...	−7·21	...	336·04
11	...	102·69	+70 δ ξ	...	7·19	...	335·85
12	...	115·88		...	7·17	...	335·68
13	...	129·08		...	7·15	...	335·51
14	...	142·28		...	7·13	...	335·35
15	...	155·47		...	7·11	...	335·19
16	...	168·67		...	7·08	...	335·04
17	...	181·87		...	−7·05	...	334·89
18	...	195·07		...	7·02	...	334·76
19	...	208·27		...	6·99	...	334·63
20	...	221·47		...	6·96	...	334·50
21	...	234·67	+80 δ ξ	...	6·92	...	334·39
22	...	247·87		...	6·88	...	334·28
23	...	261·08		...	6·84	...	334·18
24	...	274·28		...	−6·80	...	334·08
25	...	287·49		...	6·76	...	333·99
26	...	300·69		...	6·71	...	333·91
27	...	313·90		...	6·66	...	333·84
28	...	327·10		...	6·61	...	333·77
29	...	340·31		...	6·56	...	333·71
30	...	353·52		...	6·50	...	333·66
31	...	6·73	+90 δ ξ	...	−6·45	...	333·61

JUPITER.

G. M. T.		Zenographical longitude of the centre of ♃'s disc. 6h.	8h.	10h.	12h.		Angle of pos. of ♃'s axis. 12h.
1872.		°	°	°	°		°
Mar. 1	...	341	54	127	199	...	10·03
2	...	132	205	277	350	...	10·02
3	...	283	355	68	140	...	10·00
4	...	74	146	219	291	...	9·98
5	...	224	297	9	82	...	9·97
6	...	15	87	160	233	...	9·96
7	...	166	238	311	23	...	9·95
8	...	316	29	101	174	...	9·94
9	...	107	179	252	325	...	9·93

10	...	258	330	43	115	...	9·92
11	...	48	121	193	266	...	9·91
12	...	199	271	344	57	...	9·91
13	...	350	62	135	207	...	9·91
14	...	140	213	285	358	...	9·90
15	...	191	3	76	149	...	9·90
16	...	82	154	227	299	...	9·90
—							
17	...	232	305	17	90	...	9·91
18	...	23	95	168	240	...	9·91
19	...	173	246	318	31	...	9·92
20	...	324	37	109	182	...	9·92
21	...	115	187	200	332	...	9·93
22	...	265	338	50	123	...	9·94
23	...	56	128	201	274	...	9·95
—							
24	...	207	279	352	64	...	9·96
25	...	357	70	142	215	...	9·98
26	...	148	220	293	5	...	9·99
27	...	298	11	83	156	...	10·01
28	...	89	161	234	307	...	10·03
29	...	240	312	25	97	...	10·04
30	...	30	103	175	247	...	10·06
—							
31	...	181	253	326	38	...	10·08
April 1	...	331	44	116	189	...	10·11

Zenographical latitude 1°·0 North.

Zenographical longitudes and latitudes of the centres of the sketches of Jupiter, found in the *Astronomical Register*.

Sketches arranged in order of time.

G. M. T.	h. m.		long.		lat.	
1869.			°		°	
Oct. 6	9 30	...	110	—816*x*	+3·4	A 1
Nov. 1	7 55	...	15	—790*x*	+3·3	A 2
24	10 0	...	320	—767*x*	+3·3	A 3
25	10 50	...	141	—766*x*	+3·2	D 4
—	11 15	...	156	,,	+3·2	D 3
30	12 15	...	226	—761*x*	+3·2	D 6
Dec. 21	11 10	...	112	—740*x*	+3·1	D 5
1870.						
Jan. 23	7	...	252	—707*x*	+3·0	D 2
—	8 20	...	301	,,	,,	B 6
25	5 35	...	142	—705*x*	+2·9	B 2
—	6 10	...	163	,,	,,	B 3
—	7	...	194	,,	,,	B 4
—	7 15	...	203	,,	,,	D 1
—	8 50	...	260	,,	,,	B 5
31	7 30	...	35	—699*x*	+2·9	B 1
Sept. 20	15	...	311	—467*x*	+2·6	C 4
24	12 30	...	103	—463*x*	+2·6	C 1
—	14	...	157	,,	,,	C 2
26	13 15	...	72	—461*x*	+2·6	C 3
Oct. 10	12 30	...	355	—477*x*	+2·6	C 5
—	13 45	...	40	,,	,,	C 6
1871.						
Oct. 8	16 30	...	97	—84*x*	+1·2	E 2
Nov. 8	15 15	...	43	—53*x*	+1·0	E 3
9	12 30	...	95	—52*x*	+1·0	E 1
Dec. 1	11 30	...	136	—30*x*	+1·0	E 4
4	10 40	...	199	—27*x*	+1·0	E 5
—	12 30	...	265	,,	,,	E 6

Sketches arranged in order of longitude.

	long.		lat.
	°		°
A 2	15	—790 *x*	+3·3
B 1	35	—699 ,,	2·9
C 6	40	—447 ,,	2·6
E 3	43	— 53 ,,	1·0
C 3	72	—461 ,,	2·6
E 1	95	— 52 ,,	1·0
E 2	97	— 84 ,,	1·2
C 1	103	—463 ,,	2·6
A 1	110	—816 ,,	3·4
D 5	112	—740 ,,	3·1
E 4	136	— 30 ,,	1·0
D 4	141	—766 ,,	3·2
B 2	142	—705 ,,	2·9
D 3	156	—766 ,,	3·2
C 2	157	—463 ,,	2·6
B 3	163	—705 ,,	2·9
B 4	194	—705 ,,	2·9
E 5	199	— 27 ,,	1·0
D 1	203	—705 ,,	2·9
D 6	226	—761 ,,	3·2
D 2	252	—707 ,,	3·0
B 5	260	—705 ,,	2·9
E 6	265	— 27 ,,	1·0
B 6	301	—707 ,,	3·0
C 4	311	—467 ,,	2·6
A 3	320	—767 ,,	3·3
C 5	355	—447 *x*	+2·6

Assumed daily rate of rotation, 870°.2+x.

Errata. At page 12, No. 109, line 11 from the bottom, for *Browning with* read *Browning—With.* Page 16, line 3, for *this lady* read *the lady.*

Books received.—Historical note on the method of Least Squares, by Cleveland Abbe, H.M. *Scottish Meteorology*, 1856—1871, computed at the Royal Observatory, Edinburgh. New Theory of the Figure of the Earth. By W. Ogilby, Esq. Longmans, Green & Co. 1872.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.

Fletcher, I.

To Jan. 1872.

Williams, J. M.

To March, 1872.

Brothers, A.
Elliott, R.
Guyon, R.

To April, 1872.

Lewis, H. K.
Loder, E. G.

To June, 1872.

Gooch, Miss
Metcalfe, Rev. W. R.
Neison, E.
Sargent, Rev. J. P.
Slater, J.

To July, 1872.

MacAdam, J. V.

To Sep., 1872.

Pratt, H.

To Dec. 1872.

Banks, W. L.
Cunningham, G.
Davies, Rev. R. P.
Escombe, R.
Freeman, D. A.
Hunt, G.
Lee, Allen
Monk, Dr.
Rylands, T. G.
Thomson, Professor
Warriner, H.

TO CORRESPONDENTS.

It is particularly requested that all communications be addressed to the Editor, Parnham House, Pembury Road, Clapton.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to John C. Jackson, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 112. APRIL. 1872.

ECLIPSE EXPEDITION.

We are glad to call attention to a letter from a much valued correspondent, upon the extraordinary and discreditable absence of any information whatever, concerning the results of the Eclipse Expedition, from the last meeting of the Royal Astronomical Society. We quite agree with our friend, that whatever was the reason that induced those Fellows of the Society who took a part in the expedition to withhold the information from that body to which they belong, and which specially devotes all its resources to these subjects; which, moreover, is at its own cost going to publish the results of several eclipse expeditions; such conduct on their part is alike a reproach to themselves as it is a slight to the Royal Astronomical Society.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Fifth Meeting, March 8th, 1872.

Professor Arthur Cayley, F.R.S., *President*, in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last ordinary meeting were read and confirmed.

Seventy-three presents were announced and the thanks of the Society voted to the respective donors.

G. W. Roberts, Esq.,
Rev. S. J. Johnson, and
A. Hertage, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read :—

Measures of the Binary Star ξ Ursæ Majoris: by Mr. Knott.

During the last two months Mr. Knott has obtained three sets of measures, with the following results :

Position.		Distance.		Epoch.
°		"		
31·60	...	1·092	...	1872·028
29·69	...	1·111	...	1872·088
28·15	...	1·052	...	1872·138

The measures were made with a wire micrometer, on a refractor by Alvan Clark, of 7½ inches aperture, with powers of 450 and 515.

On the Aurora of February 4, 1872: by Mr. Finlayson.

The author, writing from Dover, suggests that as it is probable many other persons saw the phenomenon, comparisons between his observations and those made at a distance would give some information as to the height of the aurora. In the early part of the evening the clouds were low, and reflected a blood red light, which seemed to show its origin was at a small elevation, but as the aurora was seen simultaneously at Florence, Constantinople, &c., it is clear this was not the case. Between ten and eleven o'clock the sky became perfectly clear, and the streamers radiated from a point in the constellation Gemini, between the principal stars aud Jupiter, and if the radiant point differed at other stations, the approximate height of the aurora, and whether within or external to our atmosphere, might be deduced.

On the Russian preparations for the Transit of Venus: by M. Otto Struve.

These preparations are progressing satisfactorily and regularly. From the inquiries as to the meteorological conditions of the proposed stations the most favourable results may be anticipated, especially as to those on the Pacific coast. Two in or near Persia appear rather doubtful. There will be a chain of twenty-four stations extending across the Russian empire, from Kamtschatka to Circassia. Each of these will be equipped with one instrument only for observing the transit. These include heliometers, photoheliographs, and equatorials of various sizes. The observers are pretty well decided on, and they will assemble at Pulkowa for training in the present year. The twenty-four observers will not be required to determine the geographical position of their stations, but this will be done afterwards where successful observations have been obtained, by the regular naval staff. In Germany the preparations are not so far advanced, but the necessary funds will probably be voted this spring. Meanwhile M. Winnecke is occupying himself with the photographic apparatus, and M. Zöllner with preparations for the spectroscopic observations.

Mr. Dunkin said this was a very satisfactory account, showing there would be twenty-four places in the Russian empire where observations would be made to be used for comparing with the stations occupied by England, Germany, and other nations. With respect to the five places selected by the Astronomer Royal for our expeditions—viz., Alexandria, Auckland in New Zealand, Kerguelen's Land, Rodriguez, and Woahoo, Mr. Airy had lately had reason to change from Auckland to Christ Church, in New Zealand, as he found that there was a much better chance of fine weather, and the sun would be higher there.

Note on the Nebula surrounding η Argus: by Mr. Russell.

The author, who is the Government astronomer at Sydney, referring to Mr. Lassell's paper on the supposed changes in the above nebula, quotes Mr. L's. expression of regret that Mr. Russell had not sent a drawing with the paper forwarded to Sir J. Herschel, and which was handed to Mr. Lassell. Mr. Russell now says that on 24th March, 1871, he sent to Sir John Herschel four copies of a drawing of the nebula, accompanied by measures of the stars, and full particulars of the instruments employed, and that on the 13th May he sent further papers to Sir John. He remarks, it is, therefore, very unfortunate that through Sir John's illness and death the papers got into Mr. Lassell's hands without the accompanying drawings.

On the Total Solar Eclipse of December, 1871: by Mr. Russell.

The Royal Society of Victoria having arranged to observe the eclipse, the Government of New South Wales voted 300*l*. for the same purpose, and the author with five other persons started on the expedition in company with the Victoria observers on November 27. They proceeded to Sidmouth and established their two observatories on a sandbank in the harbour.

Mr. Russell had a number of telescopes both equatorially mounted and otherwise. One was fitted with a camera at the eye end to photograph the eclipse, and an ordinary photographic camera was also mounted for the same purpose. The instruments were all put up and adjusted in good time, and photographic practice commenced. They ascertained that it was quite possible to take a plate out of the bath, keep it for 10 minutes, expose it, keep it for 10 minutes more and then develope it, without injury to the result. A violent storm of lightning and rain occurred the night before the eclipse, and the day itself was most unfavourable. Just before the totality a thin crescent of light was seen, but during the totality nothing could be detected but a faint light in the sun's direction. Nine plates were prepared and two exposed for 40 seconds each; but no trace of a picture was obtained. It was by no means so dark as expected, but a peculiar

blue tint pervaded the atmosphere. There was little difficulty in reading ordinary print. About fifteen miles to the north the eclipse was seen by the crew of a small vessel. Mr. Russell was unable to obtain any spectroscopes, but could have had more telescopes had spectroscopes been procurable.

Capt. Noble and other Fellows expressed their regret that the Society had not received any accounts of the Eclipse from the numerous successful observers, and it was explained that the expedition having been organised by the British Association, who obtained the funds from the Government, the reports would probably be made to that body in the first instance, but that there was little doubt they would be handed to the Astronomical Society for publication, and that every Fellow would obtain a complete account of all the eclipses from 1860 to 1871.

Observations de la Planete 117 (*Lomia*): by M. Stephan.

These were made between September 12 and October 1, at Marseilles.

Nebuleuses découvertes et observées a l'Observatoire de Marseille: by M. Stephan.

This was a table of positions with remarks.

On the longitude of Teheran: by Col. Walker.

The experiments to determine this point were made in September last by means of the Indo-European telegraph. Col. Walker being in London and Major St. John at Teheran. The signals were sent to and from Greenwich and Teheran, and although the distance was 3,870 miles, and five relays were necessary, the time occupied was less than half a second, showing that the line is in a high state of efficiency. The result for Teheran was 51°54′ 56″ E. of Greenwich, which agrees very closely with the longitude, as calculated from Madras, the position of which observatory has been obtained during the Indian Survey, but it is hoped that it will soon be possible to connect Greenwich and Madras by telegraph, and obtain the longitude in that manner.

Mr. Dunkin compared the velocity of the current in these experiments with the American result of 7,200 miles in 8-10th's of a second, and showed that the Teheran velocity was slightly slower, but two more relays were used, so that the results are fairly uniform.

Summary of Sun Spot Observations at Kew during the year 1871: by Messrs. De la Rue, B. Stewart, and Loëwy.

The figures for each month were given, the total being that on 219 days 271 new groups were registered, and that there were no clear days without spots. A comparison of the two years 1871 and 1870 shows that the latter year included the maximum of spots. Not only was the number of new groups less in 1871,

but the magnitudes were smaller. This bears out the opinion that during the progress of a period to maximum, there is an increase of area from day to day and year to year. During last year one spot appeared in the unusually high latitude of 43°, and several others nearly as high, but they were small as compared with those in the usual zone of spot activity, and appear to be the result of violent and sudden eruptions.

On the Use of the Two Eyes in detecting the Motion of the Clouds, etc.: by Mr. Percival.

On Uniformity in the Measurement of Position-Angles with the Telescope: by Captain William Noble.

This paper was designed to place on record an oral suggestion made on the night of January 12 last. The suggestion was that one uniform system of measuring position-angles in the field of a telescope should be adopted. Every double-star observer in the world, without exception, measures the angle made with the meridian by a line joining the two components of the system, in a manner which is well-known and in which (assuming the ordinary Huyghenian or the Ramsden eye-piece to be employed) the bottom of the field is, of course, the true north; and the degrees are measured from this point to 90° on the right, and so round the circle. When, however, we come to study the predictions of occultations of stars by the moon, given in the "Nautical Almanac," we find the angles at which disappearance and reappearance are computed to take place no longer reckoned from the north round by west, south, and east; but having their initial point at the south, and being measured round by east, north, and west. No reason is assigned for this, and it seems to introduce a wholly needless complication, and one particularly embarrassing to the student and young astronomer; and it was submitted that the mode of reckoning angles in the case of lunar occultations should be assimilated to that employed for measuring the position-angles of double stars. This need not, of course, prevent a supplementary calculation of the angle from the moon's *vertex*, if thought necessary; but even this should be measured in the same direction.

Note on an Unsuspected Cause of Diffraction Phenomena in a Telescope: by Captain Noble.

Some little time ago in observing Jupiter, the author remarked certain emanations which appeared to have their origin in diffraction. He was very much puzzled to imagine in what way they arose, as his telescope is excellent and in perfect order; and so far as he could see by looking up the tube at the Moon or Jupiter, the tube itself was free from obstruction. However, about the middle of last month, when observing the sun one

morning, upon removing the eye-piece, he happened to glance obliquely up the tube, and saw brilliantly illuminated by the sun a perfect *grating* of excessively fine spiders'-webs spun vertically across the interior of the telescope, somewhat within the focus of the object-glass. He speedily removed the offending lines, and had the pleasure that same evening of viewing the Jovian system shorn of all its optical appendages. The author could not say what species of spider produced a web of such extraordinary tenuity, but it certainly must be an extremely minute one, not only on account of the excessive fineness of the filaments which it spins, but also in order that it could have found its way inside of a tube so thoroughly and carefully closed.

Col. Strange said that there certainly was an insect which had an affection for spinning in telescope tubes, as he had seen instances of it.

Dr. Huggins remarked, that the spiders had already found their way into his large telescope, where, however, they appeared to do no harm; but in a transit they had made use of the spider lines already there, and spun the web upon that foundation.

The Source of Solar Heat; by Mr. Hall.

The author supposes that the sun is slowly and continuously contracting, and thereby produces an enormous amount of heat, and enters into calculations to show that it would be ages before any visible diminution of the sun's bulk would be perceived by us. The contraction, though so small as not to disturb our usual notions about the sun, would yet be a cause adequate to produce the resulting effect. Some further observations on the contraction of other bodies are added.

Note on Colour as affected by variation of Optical Power: by Col. Strange.

At a recent discussion at one of the Society's Meetings on the colours of the planets, Col. Strange expressed an opinion that of the three elements—colour, form, and size—it was most difficult to compare observations of the first by the same observer at different times. He has lately had an experimental illustration of the difference produced by the use of increased optical power. Being at a theatre with two ladies, one reputed to have an excellent eye for matching colours, and the other a born artist, their attention was attracted by the dress of a lady at a distance, which his companions pronounced *pink* and he thought *yellow*: upon using an opera-glass his opinion was confirmed, and the ladies, too, when thus optically assisted, admitted the colour was yellow. The dress was not all alike in colour, and it was a very pale tint. The light was strong, and the distance the diameter of a small theatre. This bears on the question of planetary colours as seen

under different circumstances, and Mr. Lassell has recently stated that the colours of Jupiter are best seen with high powers.

Capt. Noble enquired whether the curtain or act-drop was up or down at the time, as the effect of contrast on the retina might have produced the confusion?

Col. Strange: The effect was noticed at all times of the evening. I always saw the dress yellow, the others only when using the glass. I made a point of getting near the lady, and finding out that it was really yellow, and that it was a fabric raised in parts.

On a Double Image Micrometer: by Mr. Browning.

A Fellow of the Society having asked for a double-image micrometer, Mr. Browning promised to do his best, but hardly knew which form he disliked most. The article is a desideratum, as it requires no light to put out the object, and can be used with a bad clock or none at all. The plan he hit on was to divide a Barlow lens. He did not actually construct a Barlow lens, which is a difficult matter, and then cut it, but a third lens of a compound eye-piece might theoretically be so considered. The power was altered by using stronger eye-pieces in front.

On a Telespectroscope for Solar Observations: by Mr. Browning.

The author had lately introduced and recommended a compound prism, and proposed now to use one in making a simpler solar spectroscope. At present the whole battery of prisms is very heavy, and, although a special contrivance is described in *Schellen*, it possesses great leverage, and cannot well be used in ordinary telescopes. He had, therefore, constructed the instrument exhibited, which, though of light weight, by using a compound prism was equal in effect to twelve ordinary prisms.

On an Automatic Universal Spectroscope: by Mr. Browning.

Another instrument which Mr. Browning exhibited and described was a spectroscope that could be used for any purpose, either in the laboratory or observatory, and in which the dispersive power could be varied as well as the magnification. It had a considerable number of prisms, but by interposing a reflecting prism in any part of the train, any number could be cut off as required, and the power thus varied from high to low. All the prisms are automatically adjusted for the minimum angle of deviation, and the source of light and telescope remained fixed during the changes of dispersive power.

Capt. Noble stated that as to the double-image micrometer, John Dollond first cut a lens in half, and thus made a micrometer, but he believed that the matter dropped. Sir D. Brewster described a micrometrical telescope made by shifting a lens up and down in the tube, and Dr. Pearson suggested dividing this lens, but he (Capt. N.) thought the idea never went beyond being put on paper.

Mr. Buckingham said he possessed the original Dollond micrometer.

Capt. Noble said it might be an encouragement to the possessors of small aperture telescopes to mention that on last Tuesday, with his 4.2 inch equatorial and a Browning star spectroscope, he had got upon a solar prominence and saw the hydrogen and sodium bright lines C, D, and F, and he believed anyone by travelling round the sun would get some of the Fraunhofer lines reversed. On another day he saw them broken, indicating some singularly formed prominence.

Dr. De la Rue said he took a good deal of interest in the micrometer question, and must call attention to Mr. Airy's double image micrometer, which he (the speaker) had possessed many years, and he could not but think Mr. Browning's resembled it almost exactly. He felt sure that Mr. Simms would be able to corroborate this. He also wished to mention that a M. Cornu, now in England, had contrived a prism which, by reflecting the rays four times backwards and forwards, gave nearly the same power as Mr. Browning's.

Mr. Huggins would make only one remark. M. Cornu used a very large prism, with a large telescope and long collimator. He, therefore, might get a great dispersion of the lines, but it was not so much due to the prisms as in the spectroscope on the table.

Mr. Browning said he had heard of M. Cornu, but had not seen him. He understood that M. C. advocated high magnifying power which he thought as good as dispersion, but there was a great difference in the result. To get a ray reflected backwards and forwards four times in a prism would require a very large piece of glass which, he thought, could not be obtained.

Dr. Huggins said silvered glass was used.

Mr. Browning: Then we get colour and lose much of the light.

A gentleman remarked that at the Royal Institution, Cork, there used to be a $3\frac{3}{4}$ inch Dollond telescope, said to be the brother of Dr. Kitchener's *Beauclerk*, which had a double-image micrometer, formed by a divided lens fitting over the object-glass. It was not an achromatic lens, but seemed a very flat concave one.

Col. Strange: This would produce the effect, but would require much more actual motion of the semi-lenses than if placed near the focus of the object-glass. Ramsden's Dynameter or Dynamometer is another form of double-image micrometer, but this is placed exterior to the eye-piece. Mr. Browning's is intermediate, between the Dollond and Ramsden, and has the advantage that it avoids distortion of the image.

Dr. Huggins said he possessed a Dollond micrometer made for

Mr. Lawson. It has a divided concave lens placed within the focus of the object-glass, and only differed from a Barlow lens in not being achromatic.

Dr. De la Rue: Airy's micrometer has a concave divided lens, and, I think, is furnished with three separate positive eye-pieces to vary the power. The semi-lenses are tilted, so as to get the images in the same plane.

Mr. Carpenter said he had often used the Astronomer Royal's micrometer, and taken it to pieces. It was a four-glassed eye-piece with the third from the eye concave and divided.*

On the Variation of the Position of the Orbit in the Planetary Theory: by Prof. Cayley.

On a Pair of Differential Equations in the Lunar Theory: by the same.

The President, having resigned the chair to Mr. Lassell, gave an oral explanation and illustrations of these papers.

The meeting then adjourned.

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* It may be useful to mention, as the discussion showed, that the Astronomer Royal was not the inventor of a double-image micrometer formed by dividing a lens, but he was the first to show how it could be made achromatic and free from distortion. In his original form the divided lens was convex, but about 1850 he adopted a concave lens, which is a great improvement. The power is changed by varying the eye-lens. See *Monthly Notices*, vols. 6, 10, 26, and 27.—REP.

RUTHERFURD'S PHOTOGRAPHS OF THE MOON.

We have received a beautiful specimen of these charming photographs. Nothing can surpass the admirable definition. It has been determined to issue them as photographs, as it might otherwise be suspected that they were not absolutely faithful copies. If kept carefully, there is no fear of their permanence.

LUNAR MAP AND CATALOGUE.

Mr. Birt has issued his annual report of the progress and financial condition of this work. We should have been glad to have learned that it had met with greater success, and that the subscriptions of the part year would have warranted the issue of the fifth area of the map; nevertheless, the report and balance-sheet show that sufficient interest in it is manifested to enable Mr. Birt to continue his labours. We gather from the report that a considerable portion of time has been consumed in the Plato discussion, but not without important results bearing on the present condition of a small area of the moon's surface, and showing the importance of placing in the hands of selenographers as extended a record as possible of the condition of other portions. The subscriptions for the first year, which are, as might be expected, the largest in amount, have more than defrayed the expenses of producing the fourth area of the map, and monogram of the Mare Serenitatis, which has been spoken very

highly of. We find it is the intention of Mr. Birt to issue, as soon as possible, to subscribers of three years standing a portion of the catalogue, with synonyms and copious references to the works of previous selenographers, accompanied by critical, explanatory, and illustrative notes. We wish the work success, and hope that the acquisition of new subscribers will place additional funds at Mr. Birt's disposal.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

DESIDERATA.

I cannot but express my regret that Mr. Cocks' scheme for supplying a small sidereal clock for 5*l.* (*Astronomical Register* for August, 1871, page 179) was allowed to fall to the ground, as from the photograph I obtained from him it appeared to be the very article required by many possessors of small telescopes. After some correspondence, however, I learnt that a sufficient number of names had not been received to render the project remunerative. This result I cannot but attribute, in a great measure, to the doubtless well-intentioned letters of one of your correspondents, pointing out the superiority of a clock with a 40-inch pendulum. Of this there can be no doubt; but it should be borne in mind that the purchasers of small telescopes, for whom the clock at five pounds was intended, are those who are unable or unwilling to spend large sums on astronomy; and, therefore, if they erect any shelter for their telescope it is not likely to be much larger than the instrument requires. For persons so circumstanced a large 6-foot clock would be utterly useless, as it could not stand in the miniature observatory, where a timekeeper like that which Mr. Cocks proposed to supply, though of course not of first-rate accuracy, would enable its possessor to use the circles of his small equatorial in picking up stars by day, nebulæ, etc. As I am placed, with only just sufficient room to work the equatorial, such a clock would be more useful to me than a tall ninety-guinea instrument with its compensated pendulum. VECTENSIS.

AURORA BOREALIS.

On Feb. 4, soon after sunset, in bright twilight, two or three auroral, clouds of glowing crimson were observed in the South. As night came on, the sky in that direction became fitted with similar appearances ; and only for the formation of a corona in the usual position, south and east of the zenith, the display might have been referred to an extraordinary extension of an Aurora Australis. For a considerable time, while the south was brilliantly illuminated; the north, though unclouded, looked particularly dark and cheerless ; and, though it subsequently contributed to the corona, still it played only a very subordinate part on the present occasion, when the aurora drew its chief supplies from the opposite quarter of the heavens.

The corona was of striking splendour, its many-coloured beams coming up from all sides like a gathering of rainbows. It was formed at 7h. 30m., Dublin mean time, about 18 degrees south, and four or five degrees

east of the zenith, changing its position among the stars, while accompanying the earth in her rotation. At one time there appeared about a third of a perfect corona with a white beam laid across the apex, reminding me of Mr. Carpenter's beautiful view of the comet in the current number of the *Register*.

The spaces between the brightest beams looked exceedingly dark by contrast, and conveyed the impression of *black* rays so well that, doubtless, in the case of any one who had a theory to be supported by it, the illusion that they were objective phenomena would be very complete.

Green and crimson, especially the latter, were the predominant colours of this aurora, and both gave a green line in the spectroscope. This I could distinctly see by comparison with the spectrum of a lamp. A faint red light might sometimes, with difficulty, be discerned, and there was a trace of a continuous spectrum from the green line toward the violet end.

At 9 o'clock Sirius was sparkling with unusual fitfulness in a flood of red. Shortly afterwards a fan of white light spread up from the south-east; and so perfect was the mimic dawn, that one might almost imagine that a strange sunrise was about to follow.

At about 10 o'clock the colours grew fainter everywhere, but brightened at intervals until midnight, when clouds came on and prevented any further observation.

Millbrook, Tuam : J. BIRMINGHAM.
February 8, 1872.

ANOTHER FINE AURORA.

Sir,—The auroral display of February 4, which seems to have extended all over Europe, was not seen so well here as in most parts, owing to the prevalence of cloud. Still we caught sight of it sufficiently to show what its grandeur must have been. At 6h. 7m. a rosy light was visible in an opening of the clouds in the S.S.W. At 6.35 the clouds began to break. Orion, Taurus, the Pleiades, came into view, and they were seen suffused with bright red vapour. At 6.45 Jupiter came out, and α and β Geminorum above him with a light-coloured flickering streamer shooting across the planet over the rosy brightness. At 6.50 the sky suddenly broke in all directions, and for ten or twelve minutes it was in a great measure clear. Streamers of a greenish colour, side by side, with brilliant red columns, converged to a point overhead. For two or three minutes they gave the zenith the appearance of an immense umbrella, a peculiar sight which I saw fully developed in the aurora of May 13, 1869. The coruscations of the late aurora, during the brief interval of clear sky, were intensely vivid ; more so, I consider, than in any aurora I have seen, and that is why I am induced to forward a notice of it. The beautiful hues of the phenomenon, with the brighter stars shining through it, contrasted remarkably with the dark clouds. After 7 p.m. the aurora was only visible through the breaks in the clouds, and after 8 p.m. the sky was perfectly dense, and rain commenced to fall.

Upton Helion's Rectory, Crediton, Yours very faithfully,
Devon : Feb. 8, 1872. S. J. JOHNSON.

THE NOMENCLATURE OF COMETS.

A correspondence has been going on for some weeks past in the *Astronomische Nachrichten* on this subject, originated by the editor in consequence of the confusion which has crept in with respect to the Comets of 1871, owing to their following rather closely upon one another,

whilst the dates of their perihelion passage could not in some instances be certainly determined with promptitude.

In the general indexes to the first twenty volumes of the *Astronomische Nachrichten.* The designations of the Comets were first introduced by means of Roman numerals, and they were arranged in the order of discovery. The compiler of the index of Vol. XXVI. made the order dependent on the epoch of perihelion passage, and this system has been uniformly adopted since then in the pages of this publication. In 1863 the numbers of the Comet had continually to be altered, and alterations had also to be made in the accounts sent in by the observers. These various inconveniences are very generally admitted, and M. Oppolzen suggests a system based entirely upon dates of discovery, arranged in the following fashion :—

The first Comet of 1871 having been discovered on April 7, 1871, he would symbolise the Comet as :—

$$\textit{Comet}\quad 18\frac{7}{\text{IV.}}71.$$

The second Comet of the same year having been discovered on June 14, he would thus indicate it :—

$$\textit{Comet}\quad 18\frac{14}{\text{VI.}}71.$$

and so on. A Comet known by a specific title he would allude to as :— *Comet of Encke*, 1871. How far this system would work is, I think, open to serious question. G. F. CHAMBERS.

JUPITER AND SATELLITES.

Sir,—The transits of Jupiter's satellites are now taking place at lower Jovian latitudes, and will for some time continue to approach his equator, so that we may be able to collect observations sufficient to clear up some of the unsettled points in this system. It is at least doubtful whether succeeding transits really present 3 and 4 under a markedly different aspect. Permit me to invite the assistance of every observer, having sufficient interest and leisure, and to suggest two or three essential points in the inquiry—

1. The path of the satellite referred to zones or belts. (Mr. Gledhill's Nos. will be useful.)
2. Particulars of distance from limb (which may be estimated by the diameters of planet or satellite), or time from ingress to egress, when any change in tint or visibility occurs; or,
3. Peculiarities in shape or markings.

All sizes of telescopes will be useful, and if a good number of amateurs will help during the next three years, I hope we shall be furnished with sufficient evidence to determine whether the light and markings are permanent, and the rotation analogous to that of our moon.

As a small contribution, allow me to add what my 9-in. "With-Browning" showed of the Tr. of 3, December 29, with power 212.

The satellite traversed Gledhill's No. 5 a little below the centre of the belt. When about 3″ clear from the limb I completely lost it, and at 6″ it was distinctly coming out as a dark spot, very much smaller than its shadow (then on the disc). It became plainer and larger up to mid-tr., when the dark spot was elongated N.E., S.W. I thought in steadier moments I could see a brighter segment S.E. Its tint was dark grey, very different from the black umbra.

The latter was on the same belt, slightly S. of the path of 3. The air was not sufficiently good to allow the penumbra to be certainly seen until approaching the middle, and then it was not quite so easy as in Nov., 1869, when near the pole, but its breadth seemed about the same. At this time a bright speck just *f* it at least kept pace with the shadow for some time. Had this shadow been that of the 4th, the spot would have passed underneath and left it behind, causing, to an observer on Jupiter, the remarkable phenomenon of a solar eclipse, commencing on the E. of the sun. Under certain circumstances this might be nearly intermediate between two normal eclipses occurring near sunrise and sunset. The observation of this local retrogression will be interesting to those whose optical means are adequate. (Fuller details may be found in *Eng. Mech.* xiv., p. 387.)

Some changes on Jupiter would seem to have taken place since Mr. Gledhill's observations earlier in December. On the 29th, about 11h., there were two large (E. and W.) bright masses on the same meridian of belts 3 and 4, having dark borders and darker ends, about 15″ from the W. limb, with others in a similar position towards the E. A few quieter minutes, about 13h., the whole disc was covered with markings. The boundaries of the equatorial zone contained large white masses. White zone α had a large round brighter mass, with several *f* it. Zone β was of a similar character. Belt 2, ruddy chocolate, was irregular and knotty. No. 6 was broken about, with a curved dark line enclosing a large bright mass on β. The colour of the ground of the equatorial zone seemed to me a pure deep yellow, not ochre as in 1870, but having the darker portions usually seen hanging down from No. 4, between the bright ovals.

I am, Sir, yours very truly,

Bonner's Road, Victoria Park: T. H. BUFFHAM.

Jan. 12, 1872.

P.S.—Allow me to add, under the third point, that the position of markings, detected on a satellite, should be referred to the equator of Jupiter, and not to the *p* and *f* motion through the field.

I have obtained no observation worth mentioning since Dec.

Feb. 14, 1872. Yours truly, T. H. B.

JUPITER.

SIR,—On the night of Feb. 20, at 11½h., the face of the planet was a magnificent picture. Something, doubtless, was due to favourable circumstances, but more to an unusual display of the features, which lately have increased our interest, and attracted our attention. At this time, the whole of the disc was covered with spots, or other markings. The streak between No. 2 and No. 3 was narrow, and the space between it and No. 3 was filled with bright masses, interspersed with marbled markings. The whitest part of the disc was below No. 2, and even this was divided by an exceedingly fine line,—really another belt between No. 1 and No. 2. No. 2 was knotted, and also had on it one or two bright beads. The upper half of Jupiter was also full of detail. The three principal belts were very irregular, the general character being a dark stratum, on which were superposed lighter small elongated masses. One of these, in the latitude of No. 5, assumed large proportions—perhaps 6″ in length—its upper very dark boundary bulging out of the S. of the belt, while its fainter lower border dipped into the bright zone between No. 4 and No. 5.

The colour of the central part of the equatorial zone is still, to my eye, of a deep yellow, without any warmth of tint. Casual notice shows it extending across fully three-fourths of the planet. Careful watching,

however, reveals it almost to the limb on the western extremity; on the other end, where the terminator is, it cannot be traced quite so far, (with power 212.)

The bright masses on the upper side of the zone I usually see of less regular sizes than they are generally drawn by your correspondents. At 10h. on the 21st Feb. one was observed having three or four times the area of its companions.

I am, Sir, yours truly
T. H. BUFFHAM.

Bonner's Road, Victoria Park:
March 15, 1872.

THE SHADOW OF JUPITER'S FOURTH SATELLITE.

Sir,—I have been enabled to scrutinise this shadow until the transit of March 6. When well on the planet, the umbra and penumbra were certainly distinguished with 212 and 320 on my nine inch "With Browning." The umbra was about equal to half the diameter of IV. outside; and the breadth of annulus of penumbra about half the diameter of the umbra. Still both parts of the shadow—which traversed the disc of Jupiter half way from the equator to the S. pole—were less clearly defined than in the shadow of III. The size of the umbra would appear to indicate that its exterior was merged with the denser part of the penumbra. Near mid-transit the shadows seem smaller and darker; near egress its compound character was again visible.

Soon after ingress, two small light spots were noticed, just preceding, and a little below the shadow. When the latter had reached the middle of its course, the two spots had gained some $1\frac{1}{2}''$ on it. Nearer the equator, the local retrogression would have been more marked.

I am, Sir, yours very truly,
T. H. BUFFHAM.

Bonner's Road, Victoria Park:
March 15, 1872.

JUPITER.

As well as I could see in weather that gives the worst telescopic definition, the slant streak that I noticed in Jupiter, on Jan. 11, has now become faint, but it has got additional features, which were first noticed on March 17. Referring to my sketch in the February number of the *Register*, an imperfect belt will be seen ending about half-way across the disc. This is Mr. Gledhill's No. 6, and above it is a belt which I will call No. 7, while still further I can sometimes distinguish another, which may be marked as No. 8. The slant streak, when first observed,* reached no higher than 7, but now it appears to extend to 8, or the dark region about the pole. In the angular space between it and 5, and reaching quite across, is a large dark spot, and under the spot a bright gap seems cut out of 5. No trace of these was noticed before March 17.

On Feb. 16, I remarked another slant streak rising in a similar direction from 5, in a place about two hours east of the first one, and, at the same time, a great thickening appeared above it in 7. From this thickening I perceived, on Feb. 24, a slant streak descending, and both streaks met at an angle at No. 6. On the same occasion I saw, for the first time, two slightly inclined, and very faint, dark, conical forms, with their bases on

* In the sketch the streak rises at too great an angle, and the space between 4 and 5 is too wide.

belt 3, and crossing the equatorial zone to 4, where they seemed to touch with their apexes two of the spots on the latter.

During February, No. 3 appeared to me not straight, but with three or four slight curves, and interrupted by bright spots in two places. This I have latterly not been able to observe.

Mr. Gledhill's new belt, which may be called 2b, never seemed complete. It distinctly terminated at two bright spots separated from each other about a tenth of the circumference. My failure to detect this belt during the present month, as well as the curves of No. 3, must be, most probably, attributed to the badness of the definition on the few occasions that the heavens were at all visible.

March 19, 1872. J. BIRMINGHAM.

LUNAR TINTS.

SIR,—May I ask for a small space wherein to say a few words on the conversation at the meeting of the Royal Astronomical Society, which ensued on the reading of my paper relative to the floor of Plato. Although your report of that conversation is perfectly accurate, it is, I think, calculated to lead the general reader to conclude that the appliances of modern science were not employed in obtaining the results which formed the subject of my communication, and, consequently, a doubt may rest on their accuracy. It is quite true that instrumental determinations carry a much greater weight with them than estimations, but no one, except a selenographer who has had considerable practice, can form the least idea of the difficulty of determining instrumentally numerical values of lunar tints. A telescope is required which is furnished not only with a perfect clock motion, adjusted to the moon's diurnal motion, but a diaphragm of the nature of Dawe's eye-piece, with exceedingly small perforations to shut off every portion of the moon's surface, except that under examination, which must be kept steadily in the field while a number of graduated tints are compared, in order to select the one which agrees best with it. The wedge of coloured glass, of which I said "nothing could be better," would determine rather the intensity of the light reflected from the object than the colour presented by it. Up to this time "estimation" has been used in determining *brightness*, and in the lower part of the scale *colour*. Schröter, Lohrmann, and Mädler, adopted this plan, and although the scales of these selenographers are not identical, we do not question their determinations. I may remark in passing, that, however numerous the collected instances of brightness as determined by them may be, the observations of any particular object are but few; and as regards Lohrmann's and Mädler's, the dates are not given. In the case of Schröter, the date of each observation is recorded. The paucity of observations in a given instance is a strong inducement for re-determining brightness on every available opportunity. A well-trained eye can readily estimate minute shades of difference between the colours and brightnesses of neighbouring objects, and constant practice will enable two or more observers to come very close indeed in their estimation of colour and brightness. In the case of Plato, the differience between the lightest and the darkest floor is sufficiently great to preclude the possibility of the *same* observer mistaking dark for light, and the contrary, and when three observers, during a period of two years not in communication with each other, and using telescopes of different apertures, so closely agree as to furnish the materials of a curve which rises and falls with that of solar altitudes, there can be little room to doubt of the accuracy of a result which incontestably proves that the position of the sun in the lunar heavens affects the appearance of objects on the moon's surface, a principle long held by

selenographers, but, so far as I am aware, never proved *numerically* before. Regarding a very light floor as 0·10, and a very dark floor as 0·90; a curve deduced from the observations gives for each interval of 12 hours from sun-rise to sun-set on Plato, the following values :—Interval 0 to 12 hours sun's altitude 0° 0′·0 to 3° 54′·8. Tint of floor 0·30 to 0·33.

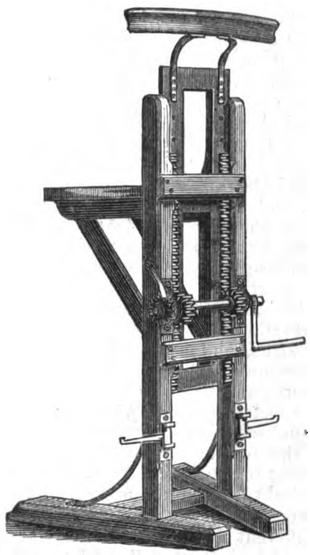
Interval	12 to 24 hours.	alt. 3° 54′·9 to 7° 48′·1.	Tint 0·33 to 0·36.
Interval	24 to 36 hours.	alt. 7° 48′·1 to 11° 38′·2.	Tint 0·36 to 0.39.
Interval	36 to 48 hours.	alt. 11° 38′·2 to 15° 23′·3.	Tint 0·39 to 0·42.
Interval	48 to 60 hours.	alt. 15° 23′·3 to 19° 2′·0.	Tint 0·42 to 0·45.
Interval	60 to 72 hours.	alt. 19° 2′.0 to 22° 31′·3.	Tint 0·45 to 0·49.
Interval	72 to 84 hours.	alt. 22° 31′·3 to 25° 49′·5.	Tint 0·49 to 0·52.
Interval	84 to 96 hours.	alt. 25° 49′·5 to 28° 54′·3.	Tint 0·52 to 0·54.
Interval	96 to 108 hours.	alt. 28° 54′·3 to 31° 42′·7.	Tint 0·54 to 0·57.
Interval	108 to 120 hours.	alt. 31° 42′·7 to 34° 11′·5.	Tint 0·57 to 0·60.
Interval	120 to 132 hours.	alt. 34° 11′·5 to 36° 17′·5.	Tint 0·60 to 0·62.
Interval	132 to 144 hours.	alt. 36° 17′·5 to 37° 57′·8.	Tint 0·62 to 0·64.
Interval	144 to 156 hours.	alt. 37° 57′·8 to 39° 9′·2.	Tint 0·64 to 0·65.
Interval	156 to 168 hours.	alt. 39° 9′·2 to 39° 50′·5.	Tint 0·65 to 0·66.

Interval 168 to 177, or meridian passage alt. 39° 50′·5 to 40° 0′·0. Tint 0·66 to 0·67. The declining sun gives the same altitudes and tints from meridian passage, reckoning in the reverse order,

I am, Sir,
Your obedient servant,
W. R. BIRT.

Observatory,
Cynthia Villa, Walthamstow:
January 9, 1872.

NEW OBSERVING SEAT.



Sir,—The want of a comfortable seat suitable for observing with reflecting telescopes has been long felt. I beg to send you a photograph of an Observing Seat I have just constructed for my 8½-inch "*Browning-With*" Reflector, which I find to answer its purpose very satisfactorily, and which may, therefore, be interesting to your readers.

There are many difficulties to be overcome in contriving a seat for reflectors on Alt-Azimuth stands :—

First, it is essential that in using it, the observer's legs should not be in front as on an ordinary chair, for it would then be impossible for him to approach his eye to the eyepiece in every position of the telescopes.

Secondly, it is necessary that the seat should be moveable vertically to at least double the height of its lowest position ; and, Thirdly, the height of the seat should be readily adjustable without the observer moving from it ; and at the same time the whole thing should be quite simple and portable.

The seat I have made attempts to comply with all these conditions. It consists simply of a saddle-shaped seat, attached to a frame sliding in a groove in two uprights, the height regulated by cogwheels and rackwork.

The whole is constructed of well-seasoned oak, with the exception of the "saddle" which is of lime.

The two uprights are firmly morticed into two horizontal bearers, braced together and strengthened by iron stanchions. The seat is of Lime wood, shaped and hollowed like a saddle, and the observer sits astride on it as on horseback. This "saddle" is fixed to what joiners call a "gallows-shaped bracket," firmly screwed to a frame sliding easily in a vertical groove in the uprights. Attached to this frame in front are two gunmetal racks, and at the top is fixed by iron supports, a curved oak bar like the back of a chair, which enables the observer to lean forward without fear of falling, and serves as a support for his arms in focussing, measuring, and observing with greater steadiness. The cogwheels are of gunmetal, and are fitted and keyed on an iron shaft working in front of the uprights. At one end of this shaft is an iron catchwheel which regulates the height of the seat.

The bearers are braced together behind the uprights, and are left open in front, so that when the telescope is at its greatest elevation, and its most distant position in Azimuth, one angle of the tripodic stand of the telescope can be admitted between the uprights, and thus allow the observer to get up to the eyepiece—this being the position of the telescope most difficult for any seat to be used.

The footrests are of iron and fixed to the uprights—they are moveable, and made on the principle of the rack-bracket on which a roasting jack hangs, having a round socket above and a square one below, so that when the seat is low down and they would be in the way, they can be easily turned inwards. (I should say that my reflector being of short focus, I find one pair of foot rests sufficient ; but with a *longer* telescope, a second pair would of course be necessary.)

To raise the seat when observing, it is only necessary to stand up on the foot rests and pull it up by the top bar ; to lower the seat, it is easy to stand on the foot-rests and with the right hand release the catchwheel, the seat will then fall of its own weight ; the height of the seat is thus most easily and readily adapted to the object under examination. The bearers rest upon small wheels in front, so that the observing seat can be run easily to and from the telescope.

The whole seat is very steady and firm, the arrangement of the bearers forming two sides of a triangle, make it difficult to upset sideways, and they are sufficiently long to prevent any unsteadiness backwards or forwards. It is very comfortable and sufficiently portable. I find no difficulty in carrying it into the garden each night I observe.

I am indebted to Mr. Browning for most kindly suggesting to me that it would be an advantage to have a small shelf fixed at the top of the frame under the curved bar, with holes pierced in it to contain

the eyepieces mostly in use. Mr. Browning thinks also that if an upright iron bar were attached to one end of the curved bar, a light semi-circular frame of galvanized iron work might be made to swing on this, and after the observer had taken his place, he could turn it round and secure himself against the effects of wind—both very valuable suggestions which I shall endeavour to have carried out.

I append a few dimensions :—

Uprights	3ft. 7½in.
Horizontal bearers	2ft. 5in.
*Height of seat at lowest position	1ft. 10in.
Height of seat at highest position	3ft. 7in.
Greatest elevation of eyepiece of telescope being	5ft. 11in.

Burton-on-Trent : I am, Sir, yours faithfully,
March 9, 1872. E. B. KNOBEL.

P.S.—With regard to the cost of the above Observing Seat, I should perhaps mention that one of that size would be about £5, exclusive of making the patterns for the castings, the metal-work costing at least half the money. I did not aim at cheapness so much as simplicity and portability, but the expense might be much reduced by using other wood instead of oak, and also by having the cog-wheels and racks of iron instead of gun-metal, but they would not work so smoothly, and the seat would not be so durable. E. B. K.

*A very trivial alteration in the position of one of the braces connecting the uprights would allow the seat to go 1¼ inches lower.

We have also received an observing chair suited for a refractor, the particulars of which will be seen among our advertisements. It is remarkable as to lowness of price.

THE ECLIPSE EXPEDITION OF THE ROYAL ASTRONOMICAL SOCIETY.

Sir,—In common, I believe, with a very large number of those who crowded the meeting-room of the Royal Astronomical Society on the night of Friday last, I went down for the express purpose of hearing the details of the results of the late Indian Eclipse Expedition.

To my exceeding surprise and chagrin, not one syllable was said about it, save by a member of the council, who very pointedly referred to the conspicuous absence of those fellows who might reasonably have been expected to have been present, to have given us some information

Why then, I would ask, have the society not been favoured with any account of the observations made by their own fellows? I see it stated in the public prints, that the expedition was sent out by the Government in the representation of the British Association. It therefore might possibly be conceived and urged that the observations made were the property either of the Government or of the Association. In the first case, of course, no one could deal with them, and they would probably be printed by the Admiralty ; in the next, those who made them would have equally little control over their publication ; and would have to keep them warm until the meeting next August, at Brighton.

But, if I am rightly informed, there is a serial called *Nature* which has already contained reports of the Indian observations, and, unless I have curiously misread the newspaper, Mr. J. Norman Lockyer has been lecturing on this very subject at the Crystal Palace ; so that, at all events, he treats *his* observations as private property.

During the desultory conversation which ensued after the meeting broke up, it was hinted that the results of the late expedition are being

saved up for the Royal Society. If this be so, I would simply express my opinion that any one who (being a fellow of the Royal Astronomical Society) would deliberately withhold information of a purely astronomical character from the Society solely devoted to the advancement of astronomy, merely that it might first be communicated to the "superior classes" at Burlington House, *ipso facto*, would enrol himself in a category to the exposition of whose manners and customs, the late Mr. Thackeray devoted a never-to-be-forgotten "book."

I am, Sir, your most obedient servant,

March 9, 1872, DESTITUTUS.

THE NATIONAL THANKSGIVING.

Sir,—It was stated in the newspapers that seats were to be reserved in St. Paul's Cathedral for the representatives of Science, on the occasion of the National Thanksgiving on the 27th of last month. I ask, in some wonder, is, or is not, Astronomy at the head of all the Sciences? And, if so, how is it that the Royal Astronomical Society was absolutely unrepresented amid the vast and heterogeneous assemblage which met in our great Metropolitan Church to offer up praise to Him whose glory the heavens so emphatically declare?

It is infinitely discreditable to the authorities that no invitations whatever were issued either to our President, Officers, or Council; in point of fact, that the very existence of the second of all the Learned Societies was absolutely and utterly ignored.

Possibly Cole, C.B., and his pushing impudent South Kensington clique, occupied the space supposed to be devoted to the *elite* of English intellect; but who—save the members of the Mutual Admiration Society at Brompton—would dare to assert that any of these people have the smallest claim to be regarded as men of science, or to sit in the place of our representative philosophers?

Whether other scientific bodies have received such treatment, and if so, whether they will resent it, I know not; but, as far as we are concerned, I regard the indefensible slight which has been put upon us as an insult to every

FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

March 12, 1872.

T. CORONÆ BOREALIS.

Sir,—It will be remembered that, in May, 1866, this star suddenly burst forth, and rapidly decreased again; and that, after a smaller increase, it began in the autumn gradually to diminish, and continued doing so till the middle of 1867. Since that time, up to the beginning of this year, its brightness has not changed materially, though there have been slight and irregular variations. The last observation I recorded last year was on October 16, when it was just of its usual brightness. On January 14 it appeared to be slightly fainter, but the difference could be fully accounted for by error of estimation. I did not again look at it till March 5, at 11, when I was at once struck by the change, and found it perhaps half a magnitude fainter than usual, and decidedly fainter than I ever before saw it. I have looked at it several times since then, up to the 12th, but have not detected any further change, so that I cannot say whether its diminution continues or not.

I do not know what T. Coronæ was like before 1866, so that I cannot say whether it is now brighter or fainter than then.

Yours truly,

Sunderland: March 15, 1872. T. W. BACKHOUSE.

ASTRONOMICAL OCCURRENCES FOR APRIL, 1872.

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m s.	h. m. Jupiter —
Mon	1	 4 50	Sidereal Time at Mean Noon, 0h. 40m. 36·24s. Conjunction of Moon and Saturn 3° 19′ N.	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	7 40 8 57 10 0 11 17	6 46·5
Tues	2			1st Ec. R.	8 24 6	6 42·8
Wed	3					6 39·1
Thur	4			3rd Ec. R. 2nd Oc. D.	8 3 54 13 42	6 35·5
Fri	5	7 23	Conjunction of Moon and Venus 3° 59′ N.			6 31·8
Sat	6		Saturn's Ring: Major Axis=37·31″ Minor Axis=14·59″	2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	7 59 10 32 10 54 13 28	6 28·2
Sun	7	12 31	● New Moon	1st Oc. D. 3rd Tr. I.	12 16 13 21	6 24·5
Mon	8	4 21 20 1	Conjunction of Moon and Mars 3° 42′ N. Conjunction of Moon and Mercury 6° 32′ N.	4th Tr. I. 2nd Ec. R. 1st Sh. I. 1st Sh. I. 1st Tr. E. 4th Tr. E. 1st Sh. E.	7 43 8 25 49 9 35 10 52 11 54 11 56 13 12	6 20·9
Tues	9			1st Ec. R.	10 19 34	6 17·3
Wed	10			1st Sh. E.	7 41	6 13·7
Thur	11			3rd Oc. R. 3rd Ec. D. 3rd Ec. R.	6 52 8 38 19 12 4 53	6 10·1
Fri	12	21 5	Conjunction of Neptune and Sun			6 6·5
Sat	13	6 55 8 6	Occultation of 5 Geminorum (6) Reappearance of ditto	2nd Tr. I. 2nd Sh. I. 2nd Tr. E.	10 37 13 10 13 32	Moon. — 4 30·2
Sun	14	23 24 11 48	Conjunction of Moon and Jupiter, 2° 38′ S. Near approach of 48 Geminorum (6)			5 20·5
Mon	15	10 11 11 0	☽ Moon's First Quarter Conjunction of Moon and Uranus, 3° 0′ S.	2nd Ec. R. 1st Tr. I. 1st Sh. I. 1st Tr. E.	11 15 11 30 12 47 13 49	6 10·4
Tues	16			1st Oc. D. 1st Ec. R.	8 40 12 15 4	6 59·3

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Wed	17		Sidereal time at Mean Noon, 1h. 43m. 41·10s.	1st Sh. I. 1st Tr. E. 1st Sh. E. 4th Ec. R.	7 16 8 18 9 35 10 22 32	7 46·8
Thur	18	7 59 9 16 10 14 11 10	Occultation of B.A.C. 3579 (6) Reappearance of ditto Occultation of ι Leonis (6) Reappearance of ditto	3rd Oc. D. 3rd Oc. R. 3rd Ec. D.	7 25 10 55 12 38 11	8 33·0
Fri	19	13 20	Conjunction of Mars and Mercury, 2′ 32″ N.			9 18·2
Sat	20			2nd Tr. I.	13 16	10 3·0
Sun	21					10 48·3
Mon	22			2nd Oc. D. 1st Tr. I. 2nd Ec. R.	8 13 13 26 13 36 15	11 35·1
Tues	23	1 37	○ Full Moon	1st Oc. D.	10 37	12 24·5
Wed	24	8 54	Inferior Conjunction of Mercury	1st Tr. I. 2nd Sh. E. 1st Sh. I. 1st Tr. E. 1st Sh. E.	7 55 8 2 9 10 10 14 11 30	Jupiter. 5 24·5
Thur	25			1st Ec. R. 3rd Oc. D.	8 39 30 11 30	5 21·0
Fri	26		Saturn's Ring: Major Axis=38·58 Minor Axis=15·02			5 17·6
Sat	27					5 14·1
Sun	28	11 18	Conjunction of Moon and Saturn, 3° 32′ N.			5 10·7
Mon	29	20 20	☾ Moon's last quarter			5 7·3
Tues	30					5 3·9
MAY. Wed	1			1st Tr. I. 2nd Sh. I.	9 52 11 5	5 0·6

THE PLANETS FOR APRIL.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	1 50 51	+13 41½	6″·8	1 10·1
	15th	2 23 32	+17 20	10″·0	0 47·6
Venus ...	1st	23 8 54	−6 54½	11″·4	22 24·6
	15th	0 12 20	−0 21½	11″·0	22 32·8
Jupiter ...	1st	7 28 15	+22 23½	36″·9	6 46·5
	15th	7 32 38	+22 16½	35″·2	5 55·9
Saturn ...	1st	19 29 4	−21 32½	14″·8	18 45·4
	15th	19 31 5	−21 29	15″·2	17 52·4
Uranus ...	2nd	7 57 19	+21 18	4″·0	7 11·6
	18th	7 57 43	+21 17	4″·0	6 9·1

Mercury. A good opportunity is offered for observing this planet at the beginning of the month, as it passes the meridian about one hour and ten minutes after noon, for the first week, the interval decreasing until the 23rd, on which the planet transits twice, at four minutes past noon and at one minute before noon on the 24th.

Venus throughout the month rises about half an hour before the sun.

Jupiter will be well visible throughout the month till half-past two at the beginning of the month, the interval decreasing to a quarter-past one.

Saturn may be seen in the morning, but is too low to be worth observing.

Uranus is still well situated for observation.

SUN.

Greenwich, Noon. 1872.		Heliographical longitude of the centre of			Heliographical latitude the sun's disc.		Angle of position of the sun's axis.
		°			°		°
April 1	...	19·94	+91 δ ξ	...	−6·39	...	333·57
2	...	33·15		...	6·33	...	333·54
3	...	46·36		...	6·27	...	333·52
4	...	59·57		...	6·21	...	333·50
5	...	72·79		...	6·14	...	333·50
6	...	86·00		...	6·07	...	333·49
—							
7	...	99·21	+97 δ ξ	...	−6·00	...	333·50
8	...	112·43		...	5·93	...	333·51
9	...	125·65		...	5·86	...	333·53

10	138·86		5·79	333·56
11	152·08		5·71	333·60
12	165·30		5·63	333·64
13	178·52		5·55	333·69
—				
14	191·74	$+104\,\delta\,\xi$	—5·47	333·74
15	204·96		5·39	333·81
16	218·18		5·31	333·88
17	231·41		5·22	333·96
18	244·63		5·14	334·05
19	257·85		5·05	334·15
20	271·08		4·96	334·25
—				
21	284·31	$+111\,\delta\,\xi$	—4·87	334·35
22	297·53		4·78	334·47
23	310·76		4·68	334·59
24	323·99		4·59	334·72
25	337·22		4·49	334·86
26	350·45		4·40	335·01
27	3·68		4·30	335·16
—				
28	16·91	$+118\,\delta\,\xi$	—4·20	335·32
29	30·15		4·10	335·49
30	43·38		4·00	335·66

Assumed daily rate of rotation, $14^{\circ}.2+\delta\,\xi$.

JUPITER.

G. M. T.	Zenographical longitude of the centre of ♃'s disc. 6h.	8h.	10h.	12h.	Latitude. 12h.	Angle of pos. of ♃'s axis. 12h.
1872.	°	°	°	°	°	°
April 1	331	44	116	189	+1·0	10·11
2	122	194	267	340		10·13
3	272	345	58	130		10·15
4	63	136	208	281		10·18
5	214	286	359	71		10·21
6	4	77	149	222		10·24
—						
7	155	227	300	12	+1·0	10·27
8	305	18	90	163		10·30
9	96	168	241	314		10·33
10	246	319	32	104		10·36
11	37	110	182	255		10·39
12	188	260	333	45		10·43
13	338	51	123	196		10·47
—						
14	129	201	274	346	+1·0	10·51
15	279	352	64	137		10·55
16	70	142	215	287		10·59
17	220	293	5	78		10·63
18	11	83	156	288		10·67
19	161	234	306	19		10·71
20	312	24	97	170		10·75
—						

21	...	102	175	248	320	+1·0	10·79
22	...	253	326	38	111		10·84
23	...	44	116	189	261		10·89
24	...	194	267	339	52		10·94
25	...	345	57	130	202		10·99
26	...	135	208	280	353		11·04
27	...	286	358	71	143		11·09
28	...	76	149	221	294	+1·0	11·14
29	...	227	299	12	84	0·9	11·19
30	...	17	90	162	235	,,	11·24
May 1	...	168	240	313	25	,,	11·29
2	...	318	31	103	176	,,	11·34
3	...	109	181	254	326	,,	11·40
4	...	259	332	44	117	+0·9	11·46

Assumed daily rate of rotation = 870°·72.

MOON.

Libration. Selenographic long. and lat. of the point on the moon's surface, which has the earth's centre in the zenith.

Terminator. Selenographic longitudes of the points in latitude 60° N., 0° and 60° S., when the sun's centre rises or sets.

Greenwich, Midnight.

		long.	lat.		6° N.	0°	60° S.
1872.						Sunset.	
					°	°	°
April 1	...	0·0	+4·2	...	−14·0	−11·6	−9·3
2	...	+1·0	5·3	...	26·2	23·8	21·4
3	...	2·0	6·1	...	38·3	36·0	33·6
4	...	3·0	6·5	...	50·5	48·2	45·7
5	...	3·9	6·6	...	−62·7	−60·4	−58·1
6	...	4·5	6·2	...			
7	...	+4·9	+5·5			Sunrise.	
8	...	5·0	4·5				
9	...	4·8	3·3	...	+72·9	+70·7	+68·5
10	...	4·3	1·9	...	60·6	58·5	56·3
11	...	3·4	+0·5	...	48·4	46·3	44·1
12	...	2·3	−0·9	...	36·1	34·0	32·0
13	...	+1·0	2·2	...	23·9	21·8	19·8
14	...	−0·4	−3·5	...	+11·7	+ 9·6	+ 7·6
15	...	1·7	4·6	...	− 0·6	− 2·6	− 4·6
16	...	2·9	5·5	...	12·8	14·8	16·8
17	...	4·0	6·2	...	25·1	27·1	29·0
18	...	4·8	6·6	...	37·3	39·2	41·1
19	...	5·4	6·7	...	49·5	51·3	53·2
20	...	5·7	6·5	...	61·8	63·6	65·5
21	...	−5·5	−5·9	...	−74·1	−75·9	−77·7
22	...	5·0	4·9			Sunset.	
23	...	4·3	3·7	...	+78·2	+80·0	+81·8

24	...	3·4	2·2	...	66·1	67·8	69·5
25	...	2·4	—0·6	...	54·0	55·6	57·3
26	...	1·3	+1·0	...	41·8	43·5	45·1
27	...	—0·1	2·7	...	29·7	31·3	32·9
28	...	+1·0	+4·1	...	17·5	19·1	20·6
29	...	2·1	5·3	...	+5·4	+6·9	+8·4
30	...	3·0	6·2	...	—6·8	—5·3	—3·9
May 1	...	+3·8	+6·6	...	—19·0	—17·5	—16·1

The sun's disc passes the true horizon of Linné on April 14, from 8h.·9 to 10h.·1, rising.

THE PLANET JUNO.

The Minor Planet *Juno* will be in opposition on the 20th inst.

Date.		R. A. h. m. s.		Dec. ° ′
8th	...	14 21 57	...	—1 49½
12th	...	14 20 27	...	1 20½
16th	...	14 17 23	...	0 52½
20th	...	14 14 14	...	0 25½

THE PLANET VESTA.

Mr. G. J. Walker sends us the following particulars :—

The minor planet Vesta is well placed now for observation. It is very near *ν* Cancri, 6th magnitude, and will be a very little below it in the beginning of April. It has a bright, sharp, stellar appearance. There is a small star to the left of *ν*, less bright than the planet, which seems of 7th magnitude.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN APRIL, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists of lunar objects which have been published monthly during the past year, and the first three months of the present year, contain 352 of the 404 named craters, &c., in Webb's *Celestial Objects for Common Telescopes*. Between January 23, 1871, and April 10, 1872, fifteen lunations, or 442 days 23 hours, will have elapsed, so that on April 10 and following days to the 18th the moon's morning terminator will pass over the objects given in our list for January, 1871, vol. IX., p. 18. It will be seen, on referring to that list, that on January 23 Supplement ☾—☉ at midnight was 142° 7′, and that this angle diminished to 52° 36′ on the 31st. On April 10, 1872, at midnight, supplement, ☾—☉ will equal 144° 21′, and on the 18th its value will be 55° 50′. The present month accordingly affords an opportunity for commencing a comparative series of observations of the objects given in that and the following lists.

On the 23rd of March, 1871 (see vol. IX., p. 72,) the value of ☾—☉ was 147° 34′, diminishing to 59° 4′ on the 31st. As these values slightly exceed the values for April 10 to 18, 1872, the lists for January and

March, 1871, combined, will not only furnish suitable objects for observation in April, 1872, but probably be the means of refreshing the memory as to interesting points previously observed.

Fourth Zone of objects from North to South.

Chevallier (*a*), Shuckburgh (*b*), Hooke, the Crater (*c*) marked *a* by B. & M., N.W. of Schumacher, Schumacher, Messala, Bernouilli Prom: Agarum, Condorcet, Furnerius, Frauenhofer, Boussingault, Boguslawsky.

This zone may be observed as the objects are coming into sunlight. They were well seen on March 13, the terminator passing through Atlas, Guttemberg, and Fabricius—the moon being seven days past perigee. Most of these objects are but little known.

(*a*) A ring W.S.W. of Atlas, named to commemorate the astronomical labours of Professor Chevallier. See *Monthly Notices* vol. XXIV., p. 19.

(*b*) A ring between Chevallier and Hooke, named in commemoration of Sir George Shuckburgh.

(*c*) Proposed name, Carrington.

Errata.—March 14, for *Sartner* read *Gartner*. March 21, for *Rosh* read *Rost*.

Errata in last No. of *Register*:—

Page 65, line 22 from top, for *Arcetic* read *Arcetri*.
Page 66, line 28 from top, for *something* read *something strange*.
Page 72, lines 9 and 11 from top, for *conjunction* read *conjunctive*.

By an announcement in our advertisements our readers will see that Mr. Browning has taken, in addition to his other houses of business, premises at the West End, No. 63, Strand, which will be a great convenience to the public. We wish him further success.

NEW MINOR PLANET.

We have received the following note from the Royal Astronomical Society:—

Discovery of a Minor Planet (118) Peitho, at Bilk. By Dr. R. Luther.

M.T. at Bilk.

1872	h. m. s.		h. m. s.		° ′ ″
March 15	14 18 59·6	R.A.=	12 7 26·73	N.P.D.=	79 42 33·5

From an observation made by Dr. Tietjen, at Berlin:—

M.T. at Berlin.

1872	h. m. s.		h. m. s.		° ′ ″
March 21	9 33 23	R.A.=	12 1 36·36	N.P.D.=	79 20 46·1

The daily motion obtained from these observations is in R.A. - 60s·6, and in N.P.D.—3′ 45″.

The planet is of the 11th magnitude.

March 25, 1872.

AURORA OF FEBRUARY 4.

Observed at the Meteorological Observatory at Empoli, near Florence, by P. Liverani.

After a detailed account of the preceding phases, the writer describes the following singular phenomenon. Whilst this first stratum was moving towards the south, it was followed by other similar arches at no great distance. One of these, which from 6h. 15m. to 6h. 42m. had been considerably agitated while situated in the little bear; at 6h. 48m. passed

over Jupiter, at 6h. 54m. through the middle of Orion; and at 7h. 16m. it was already in Canis Major.

There it divided itself at once into four little clouds, and losing some of its intensity of colour, disappeared by degrees, and at 7h. 40m. was quite gone. A few seconds after, the little clouds it had formed reappeared, and in less time than it takes to describe it they were seen to reunite, and to dart in all directions, jets of white light like a firework. The rays on the west and east alone remained some time, and at 8h. 12m. others appeared in number not less than ten, all which, arranging themselves on the northern side, formed as it were, a luminous fan, with its centre at B. of Orion. This novel arc, like a zenithal aurora, lasted only twenty minutes and then, gradually decreasing in size, was only entirely extinguished at about 11h. It was during this phase of our aurora that the colours of the northern zone lost some of their intensity. The meteorological state of the atmosphere presented nothing particular during the whole time of the phenomenon. There was a very light N.E. wind below, and a S.W. high up; the temperature relatively high, and barometrical pressure always increasing. We add, in the last place, that three *falling stars* were seen; one at 7h. 10m. from Vega to the near horizon, another at 8h. 25m. in the direction of Jupiter to the Pleiades; and the last at 8h. 30m. from Jupiter towards the west.

THEORY OF HEAT.

By J. Clerk Maxwell, M.A. Longmans, 1871. 3s. 6d.

If the substance had been one of those which expand in melting, the effect of pressure would be to solidify some of the mixture, and to raise the temperature of fusion. Most of the substances of which the crust of the earth is composed expand in the act of melting. Hence, their melting points will rise under great pressure. If the earth were throughout in a state of fusion, when the external parts began to solidify, they would sink in the molten mass, and, when they had sunk to a great depth, they would remain solid under the enormous pressure, even at a temperature greatly above the point of fusion of the same rock at the surface. It does not follow, therefore, that in the interior of the earth the matter is in a liquid state, even if the temperature is far above that of the fusion of rocks in ore furnaces.

It has been shown by Sir W. Thomson that if the earth, as a whole, were not more rigid than a ball of glass of equal size, the attraction of the moon and sun would pull it out of shape, and raise tides on the surface, so that the solid earth would rise and fall as the sea does, only not quite so much. It is true that this motion would be so smooth and regular that we should not be able to perceive it in a direct way; but its effect would be to diminish the apparent rise of the tides of the ocean, so as to make them much smaller than they actually are.

It appears, therefore, from what we know of the tides of the ocean, that the earth, as a whole, is more rigid than glass, and, therefore, that no very large portion of its interior can be liquid. The effect of pressure on the melting point of bodies enables us to reconcile this conclusion with the observed increase of temperature as we descend in the earth's crust, and the deductions as to the interior temperature founded on this fact by the aid of the theory of the conduction of heat. pp. 20, 21.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.

Browning, J.
Dalmeyer, J. H.
Horne & Thornthwaite, Messrs.

To Feb. 1872.

Weightman, Miss

To March, 1872.

Rivaz, Miss

To June, 1872.

Dix, F.
Flemming, Rev. D.
Rump, H. R.
Wright, Rev. W. H.

To July, 1872.

Linwood, Rev. W.

To Dec. 1872.

Abbott, F. A.
Barber, J. J.
Ceheda, Don A. R. de
Erck, W.
Knobel, E. B.
Lee, G. H.

TO CORRESPONDENTS.

It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 113. MAY. 1872.

THE ECLIPSE EXPEDITION.

Lecture at the Royal Institution.

At the Friday evening meeting on March 22, 1872, Mr. J. N. Lockyer, F.R.S., delivered a lecture on the eclipse of December 12, 1871, to a crowded audience. He commenced by saying that his business was to state the results of the Eclipse Expedition, but as such results were embodied in the large pile of MS. on the table before him, he must necessarily confine himself to the observations made by himself and Sig. Respighi. He first pointed out on a map the course of the eclipse shadow, and the stations occupied by the various observing parties. Col. Tennant, Capt. Herschel, Dr. Janssen, Mr. Pogson and others having previously selected their stations, Mr. Lockyer chose Bekul, and Professor Respighi Poodocottah, both on the mainland, other detachments of the expedition being left in Ceylon, at Jaffna and Trincomalee. Only one party out of five into which the observers were divided, failed to see the eclipse. The lecturer then described the extent of our knowledge before the last eclipse, and stated that at the preceding one in December, 1870, the hydrogen lines of the corona spectrum had been seen by Professor Young extending to a distance of 8′ from the solar disc, and 1474 Kirchhoff to a distance of 20′ by the American observers in Spain. Mr. Watson's drawings in 1870, and the reversal of the Fraunhofer lines observed by Professor Young and Mr. Pye were also noticed, and Mr. Brothers' photograph taken in Sicily

exhibited, which showed a most extensive corona, the rifts of which corresponded in position with the photographs taken in Spain. The great point left to be determined, therefore, was whether this extensive atmosphere of hydrogen and the unknown substance giving the 1474 line was reflected light or not.

The various instruments taken out by the expedition were exhibited and described, and a number of experiments performed with Mr. Spottiswoode's polarising apparatus and the electric lamp, to show the mode of using the biquartz and savart polariscopes, which were but partially successful. Illustrations of Professor Respighi's mode of observation were next given, in which it was very well shown that the usual form of the spectrum depended on a slit being used, and that with a crooked slit the form would be zig-zag, and with a ring aperture circles of colours would be produced, according to the nature of the elementary bodies rendered incandescent. Respighi now uses a prism in front of the object-glass of his telescope with neither slit nor collimator, and thus when the sun is covered by the moon, the constituents of the corona become visible as coloured rings. Mr. Lockyer's principal results were obtained by observing the eclipse through a powerful train of prisms, without any telescope at all, and he deduces from them that the structure of the corona appears to be that of cool prominences, and consists mainly of hydrogen and the matter of 1474 Kirchhoff. Professor Respighi, who was about 100 miles distant from Mr. Lockyer, saw in his instrument when the ordinary solar spectrum disappeared, a vivid red zone or ring and two green ones, the brightest of these latter being due to 1474 Kirchhoff, with vivid coloured jets where prominences occurred. Mr. Lockyer, using the instrument above referred to, saw the same rings with the addition of a violet one, being another of the hydrogen colours. The absence of the yellow, which is due to another element of the prominences, and which was seen when they and the chromosphere were observed, shows conclusively that the coronal light is not that of the sun or chromosphere reflected, but that for eight or ten minutes at least there is a true solar appendage or envelope, consisting of hydrogen and the unknown substance of the corona and the aurora. Mr. Lockyer then exhibited on the screen the five photographs taken by Mr. Davis at Békul, and others obtained at Jaffna

and Ottocamund, as well as drawings by Mr. Holiday and Captain Tupman. The eye drawings showed a much greater extent of corona than any of the photographs, and the structure was evidently radiated in these more distant regions. Mr. Lockyer reserved his opinion as to the reason of this extensive appearance, and seemed to have a lingering affection for a cause not exclusively solar in this outer part of the visible corona, which he hoped would be further examined in future eclipses. In conclusion, he spoke most highly of the assistance rendered to the Expedition by the late Lord Mayo, the local officials, the Peninsular and Oriental Company, the admiral on the station, and others, and expressed his deep regret at the sad catastrophe to the Governor-General which had happened since the observing party left India.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Sixth Meeting, April 12th, 1872.

Professor Arthur Cayley, F.R.S., *President,* in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last meeting were read and confirmed.

Seventy-one presents were announced and the thanks of the Society given to the respective donors. It was also mentioned that Colonel Babbage had presented a large photograph of his deceased father, and that Sir John Herschel had left 50 copies of his *Cape Observations* to the Society, in order that every person who received the Gold Medal or other Certificate of Merit might have a copy presented to him at the same time.

G. M. Whipple, Esq.,
H. Pratt, Esq., and
H. C. Levander, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Observations of Encke's Comet: by Mr. Hind.

The places given extended from October 8 to December 6. The observations were made at Twickenham, some by Mr. Hind, and others by Mr. Plummer.

On the Orbit of the Binary Star ξ Bootis: by Mr. Hind.

The elements of this orbit were first computed by Sir J. Herschel, and afterwards by Madler. The author sent another set of elements,

founded on later observations, with the predicted position and distance, for the next four years.

Mr. Hind also remarked that the recent measures of ξ Ursæ Majoris by Mr. Knott showed that the star is approaching its periastron earlier than the orbit assigned to it by Yvon Villarceau required, and that the angle for the present time, predicted by Capt. Jacob, is 26° behind the observed one. Great interest attaches to this star, as having been the first double-star orbit calculated,—Savary having been the computer.

On the Orbit of the Binary Star Σ 1398, *near* μ^2 *Bootis*: by Mr. Hind.

The elements of an orbit for this star were given, and the probable position and distance to 1876.

Discovery of Minor Planets 118, 119, *and* 120: by Mr. Dunkin.

The discovery of Peitho (118) on March 15, by Dr. Luther, has been already announced, and the elements given. An ephemeris from April 5 to 24 was now supplied.

M. de Launay announces by telegram that on April 9 Planet 119 was discovered, at the Paris Observatory, by M. Paul Henry, and the discovery confirmed next night by M. Prosper Henry. It is of the 11th magnitude. He also telegraphs that M. Borelly of Marseilles discovered Planet 120 on the 10th April. It is between 11th and 12th magnitude.

Observations of the Minor Planets Peitho (118) *and Ægina* (91), *and new Nebulæ discovered and observed at Marseilles*: by M. Borelly.

The places of the Planets were given, and also a list of six new Nebulæ, with the stars of comparison.

The author also, on 3rd November, 1871, observed a star in 0h. 17m. R.A., and 101° N.P.D., which was then between the 6th and 7th magnitude. On the 8th it was only of the 8th magnitude, on the 24th of the 10th magnitude, and continued without change to the 20th January, 1872, from which time he cannot see it at all. It therefore seems to be a new variable star.

On the Solar Eclipse of December 12, 1871: by Mr. Tebbutt.

The author's health not allowing him to go from Paramatta to Cape Sidmouth with the Eclipse expedition from Victoria and New South Wales, he availed himself of the instruments at Windsor to view the partial eclipse. The evening before the eclipse day was cloudy, so that he could not obtain any time observations, but on the morning of the 12th he observed some transits. A strong N.W. wind was blowing, and broken clouds passing, but they did not cross the sun, which continued clear. There were several spots on the sun, but none very remarkable. The time of first contact was given subject to a slight uncertainty,

and the periods at which the principal spots were bisected by the moon's limbs. For some time the sun's limb was particularly steady, but afterwards "boiling" began. The mountainous peaks and ranges on the moon's limb were never better seen. The solar cusps were sharply defined, without any rounding of the points. The most interesting observations were those of the thermometer in vacuo in the sun's rays. This fell continuously to the greatest obscuration, then rose again to the end of the eclipse, when it began to fall from the sun's decreasing altitude. A table was given of the readings, showing a fall from 114° to 106°, whence it again rose to 113°, ultimately falling to 93°.

On the Proposition 38 *of the 3rd Book of Newton's Principia*: by Mr. Todhunter.

This was an important mathematical paper on Newton's discussion of the moon's figure, which was necessarily taken as read. It was also connected with the preceding proposition, in which the figure of a fluid earth acted on by the moon and rotation is examined by Newton.

On the Insufficiency of existing National Observatories: by Col. Strange.

The author starts by quoting the Astronomer Royal's words in his recent paper on the devotion of a special observatory to observing Jupiter's Satellites, viz.:—"The position which the Royal Astronomical Society holds in the astronomical world may well justify it in employing its judgment and its influence in the direction of astronomical enterprises exterior to its own body." Adopting this view, and on further consideration of existing national observatories, the author finds that they were organized at a time when the objects of astronomy were few and well marked out. Thus the Royal Observatory was established in the interest of navigation, and although this object is now most liberally interpreted, it is impossible for Greenwich to follow up the numerous branches into which the science has ramified; besides which, it is not adapted for researches on the Physics of Astronomy. Greenwich may be taken as the type of endowed observatories, for, according to the annual report of the Society, there is at the other principal observatories nearly a total absence of physical research. Greenwich adheres to meridional observations, and this devotion has been productive of incalculable gain to science, and must have been pursued at the cost of great self-denial to the director who has felt compelled to resist other and more attractive objects. The author desired to raise the question whether official bodies cannot be got to take up some of those important subjects which now claim attention, and if the Government were not to be moved, whether the Astronomical

Society, or similar bodies, could not do something, and that without at all checking the zeal of private observers. All researches which require long-continued observations should be carried on at some official establishment. The labours of private individuals are liable to be interrupted by their deaths or the loss of the possession of the observatory. Individuals might strike out new fields of research, as in the case of solar physics, but this had now become too large a subject for private observers. The mapping of the moon, again, was too heavy a work for individuals, it required co-operation and assistance, or it would never be completed. The subject being thrown out for discussion, he would suggest that the systematic observation of the sun should be taken up by the Government. Changes in the sun were evidently closely connected with the climate of the globe, and, looking to the importance of this to agriculture and other pursuits, he knew of nothing that promised so much benefit as the study of the sun he advocated. The subject required immediate attention now, for two reasons:—the first was, that the photographic study of the sun spots carried on at Kew by Messrs. De la Rue, Balfour Stewart, and Löewy was about to be closed; and the other was, that a Royal Commission on scientific education and the advancement of science had been sitting two years, and had reported on the first branch of its enquiries, and was now considering the second subject, and no doubt the conclusions of that body would govern the mode of advancement of science for a long time to come.

The Astronomer Royal said: I have heard the various papers read to-night, and remarked several points in them upon which I will offer a few comments. With respect to eclipses, great attention is often paid to obtaining the times at which certain spots are covered and uncovered. It is a common feature of eclipse reports, but nothing has ever come of it, and I recommend that it never be done again. One matter connected with the late eclipse is of a most important and gratifying character, as showing the perfection of the arrangements of Society for communicating valuable information in a wonderfully short space of time. This eclipse took place in India in the morning; by noon I had received, by way of Teheran and Tiflis, very good accounts of the results, which were sent to the evening papers, and thus published in London within a few hours of the event occurring on the same day on the other side of the globe. With respect to Mr. Todhunter's paper, I am delighted that a man of his ability and leisure should have taken up such an important portion of Newton's immortal work. Both La Place and Plana have remarked the importance of the discussion contained in these two propositions, and have noticed the correctness of Newton's results as

compared with those of much later time. Professor Adams and I have talked over these methods, and observed that they are nearly identical with those of Gauss, and that the latter, with more correct data, obtained results very little superior in accuracy. It is, therefore, a striking instance of the wonderful sagacity of Newton, that, with his more troublesome method, he should in the *Principia* have anticipated the results of the best modern analysis. Turning to the paper of Col. Strange, I may observe that I have gone over the histories of most observatories, and have had more to do with organizing and arranging the constitution of many such places than any other person. From this work I have arrived at a general impression for which I can hardly give any sufficient reason, but which is, nevertheless, strongly impressed upon my mind, that no observatory can ever sustain its position unless it is connected with some secular object. Greenwich would never have existed and reached the state it is now in, if it had not been rigorously connected with navigation. The inscription over the door and the warrant appointing the Astronomer Royal insist on this connection, and point out the promotion of navigation and the determination of terrestrial longitudes as the objects of the establishment. I have, therefore, always kept this special and secular object in sight. I and my predecessors have devoted ourselves to observing the moon, not for the sake of improving the lunar theory, but for its use in obtaining longitudes, and even the altazimuth, which has done so much for the theory, was set up for this purpose also. There are two other methods by which I have sought to promote the objects of the Royal Observatory, and these are by encouraging the improvement of chronometers, for which I believe I am most favourably looked upon by the makers of those instruments; and by the dissemination of time signals, in which I am anxious to go farther than the Government will sanction. I therefore think that an observatory can never stand without some useful object, not only to prevent astronomers going mad, as they have been apt to do since the time of Flamsteed, and hence the institution of the Board of Visitors, but because Governments want to have something to show for their money. I remember talking to an old friend, a man of sound judgment and excellent sense in most matters, about my experiments on the variation of gravity in a coal mine, and mentioning that, although I provided for most of the work myself, the Government had given me some assistance towards the expense, and he asked me how much I got. I said 100*l*. Then, said he, I protest against being taxed for my share of that sum. So that you see it is not every one in the kingdom who sees the necessity of these scientific operations as Col. Strange does.

Dr. De la Rue: I am desirous of making a few remarks on the valuable communication of Col. Strange. It is known to you that, besides the work carried on at Greenwich, to which allusion has been made, there are other observations of an utilitarian character conducted in establishments supported by Government; I refer to the meteorological observations; it appears to me that observations of the Sun could be most properly undertaken at one or two of these establishments as part of their daily work. For it cannot be denied that even small variations in the amount of solar radiation must affect oceanic and atmospheric currents, and other terrestrial phenomena which act upon climate; hence it is of the utmost importance that the changes which are going on in the primary source of light, heat, and actinic force should be ascertained with accuracy. My experience in photographic observations of the sun, during the last ten years, has led me to believe that there is no other method comparable with it as to accuracy, facility, or economy, and I hope most sincerely that before long there may be established a sufficient number of observatories in the British Dominions in different parts of the globe to ensure a photographic picture of the sun on every day of the year.

That the Government attach great importance to meteorology may be inferred from the amount annually placed at the disposal of the Meteorological Department under the Board of Trade, namely, 10,000*l*. This money is administered, under the direction of a committee nominated by the Royal Society. They have organised seven principal observatories in England, Scotland and Ireland, where records are made by automatic instruments, and also several secondary stations where eye observations are made. The data collected at 8 a.m. from these, and several stations on the Continent, are discussed, and the results posted up in London by 2 p.m., and sometimes a drum is hoisted on the coast when there are indications of a storm travelling in that direction.

At present nothing more is done to place meteorology on a truly scientific basis; we are simply collecting a vast mass of data from which, in process of time, we may be able to trace upwards the laws which produce the perplexing variations in climate. By proceeding in the way we are doing, some centuries may elapse before it will be permitted to disentangle from local causes, the effects produced by cyclical changes in the amount of solar radiation. Local operations, such as cutting down or planting trees, the drainage of marshes, and the land generally, and other works, play an important part in inducing climatal changes, but I believe that the main cause of variations in the weather at particular seasons rests with variations of solar radiation.

It appears to me to be an easier process first to study the cyclical changes of the sun, and then to trace out step by step the connection of their influence on climate.

The expense of a photographic observatory, where pictures of the sun could be obtained, and there measured and discussed, would be about 400*l.* per annum. The expense is really so small that I think it should be strongly impressed on the Government that there is a necessity in the interests of meteorological science for getting at least one picture every day at some place within the British Dominions, in order that the continuity of the operations may never be interrupted by the weather. Not only should spots be studied, for probably they are not the most important features, but the faculæ also which are of great consequence. The study of the sun should also include spectroscopic observations of the prominences if possible. The Government should, therefore, be urged to take up and continue the labours which have hitherto been conducted at Kew, these having now been brought to a close. It would be quite possible to publish with the daily weather report a record of the sun's activity on the day of publication. I must add that I for one feel much indebted to Col. Strange for his very suggestive paper.

Mr. C. V. Walker: Hearing the Astronomer Royal refer to time signals, I may mention that the last official thing I did to-day was to answer an enquiry from the Government on this subject. Mr. Airy will remember requesting me to co-operate with him in giving time signals to the Horological Institute in Clerkenwell, the centre of the watch and clock trade, and I have been asked to-day whether it is desirable that these signals should still be allowed to be sent at the public expense, as it is suggested they are merely used for trade purposes. The Astronomer Royal was fully impressed with the importance of supplying time to this district, and it took us twenty-eight months to get the matter arranged. I have to-day read over the voluminous correspondence and papers on the subject, and have replied to the Government that, as far as I am aware, it appears to me entirely a matter of public interest, and not a matter of trade, or we should not help to carry it out. We felt it a matter of benefit to the public, and assisted in sending the signals from Greenwich with the greatest pleasure. I therefore quite hope that the time will still be sent.

Professor Selwyn said, that although Dr. De la Rue's series of sun pictures was about to close, his own little series would continue for the full term of eleven years, of which nine only had now expired. Of course, the continuance would depend on the speaker's life lasting so long. The period of eleven years had been

fixed upon by the advice of Sir John Herschel, who always urged that the pictures should be taken for that time, so as to include a complete spot cycle. Before sitting down, he wished to call attention to an extraordinary instance of the prescience and sagacity of Sir J. Herschel, who had pointed out the analogy of sun spots and cyclones, and referred to a possible cause of the former in currents of heated atmosphere, moving from the solar equator to the poles, combined with the rotation on its axis. Now, in the last number of the *Astronomische Nachrichten*, there was a paper by Secchi, giving the record of 2,000 prominences, in which this theory was confirmed by ocular inspection, the direction of the prominences showing currents from the equator to the poles, and also some in the reverse direction.

The Astronomer Royal said he thought the term employed by Secchi for these remarkable appearances was *penaggio*. They were of a flag-shape, arising to a certain height, and then being driven out horizontally. The form was that which he had designated the *boomerang* at the eclipse of 1851, a term which has been generally adopted since. Secchi's table showed that in about three-fourths of the number the direction was from the equator to the poles, but sufficient information was not given as to the elevation above the sun's limb. He would also remark, with respect to Mr. Walker's statement about time signals, that if it had not been for Mr. Walker there would not have been a signal sent anywhere through England at the present time. The South-Eastern Railway Company allow the wires to run from Greenwich Observatory to their line, and keep up the wires and poles; and how much did the Meeting suppose was paid for this assistance? When arranging the service he stipulated that their rights should be fully recognised in a tangible way, and the Company charged *five shillings* a year. Such an instance of liberality and interest in science was worthy of record. With regard to the general question commented on by Dr. De la Rue, he (Mr. Airy) considered the office of bodies paid by, and supported and kept in order by Government, was very simple. Such a body could not go groping about for the causes of solar changes, such as planetary conjunctions and the like, but must occupy itself in making definite series of observations. He, therefore, could not go so far as was desired by previous speakers. Of course, if Dr. De la Rue and his friends could point out any definite series of observations to check a theory of cause and effect, then a Government observatory might be employed for that purpose, but at present he thought it was the place of a Government not to establish philosophical institutions, but working bodies.

Col. Strange said, in reply, the Astronomer Royal has stated that no observatory should be started without a secular object. This has been hitherto very much the case, not because only those having such objects lead to good results, but because those not making such appeals are not appreciated. The Government is not remarkable for scientific knowledge, and the nation is absolutely destitute of science, because it has not had the teaching requisite for carrying out objects unintelligible to the ignorant. But here I am not addressing ignorant persons, and those who are insensible to any but the *cui bono* argument. Nature will not be so treated. We shall attain no great object unless we go to a fresh school; otherwise we shall infallibly make blunders. The vital defect of English science is its want of completeness. From their unhappy state of ignorance the people want something they can count. Hence we build a British Museum. I have a great respect for the British Museum, but it costs 100,000*l.* a-year, and the people go there only to see the stuffed monkeys. The Government is ignorant, and the people more so if possible. Whose business is it to teach them? We must teach them to understand that not only is the thing good in an intellectual sense, but that in time it will bring forth utilitarian results likewise. This is why I dwell in my paper upon the necessity for the study of our great luminary, as nothing can be more calculated to influence the material prosperity of the people. I may even turn round upon Mr. Airy, and say that, had he been true to his principles, and stuck only to the direct improvement of navigation, he would never have been at the head of the great establishment he directs, and which is truly a great philosophical institution.

Capt. Toynbee desired to acknowledge the great advantage he had derived from the use of "lunars." Often he might have lost a ship but for their aid. With regard to the sun, surely enough has been done by private men to induce the Government to take it up. If meteorology would gain in the manner Dr. De la Rue had referred to, by an investigation of the solar changes, a case had been made out which required every attention by our rulers.

The Astronomer Royal said Capt. Toynbee had very well put the proper plan of proceeding. Take Greenwich as an example. At its origin the theory of gravitation was pretty well established; then arose a commercial want of places of the moon for the service of navigation, and the question was whether an institution could not be started for using this theory of gravity. It was perceived that a most extensive series of observations of the moon and stars was necessary, and the Observatory was set up. It was quite correct to say that any other subject has the same claim to beattended to as the moon, now that the latter is pretty well

done with; and much other work is, in fact, now carried on at the same time at Greenwich. If theory or antecedent observation show a worthy object, the necessary investigation should be sanctioned.

On the Law of Facility of Errors of Observation and on the Method of Least Squares: by Mr. J. L. W. Glaisher.

The author read a portion of the historical introduction of this paper, and explained his mathematical views by formulæ.

Second Part of a Memoir on the Development of the disturbing function in the Lunar and Planetary Theories: by Professor Cayley.

The author explained that the former part of this memoir had been written in 1859, and that he had not completed it until now.

Mr. Browning exhibited *Photographs of the late Eclipse* mounted stereoscopically, which showed the moon standing out in front of the corona. The photographs had been placed at his disposal by Lord Lindsay, having been taken at Bekul by Mr. Davis at Lord Lindsay's expense. Mr. Browning considered they showed the structure of the corona better than any other photographs, although it was not so extensive as in Mr. Brothers' negative, taken at Syracuse in 1870.

Dr. De la Rue having examined the stereograph, said that in 1860, when he photographed the eclipse in Spain, he combined some of the pictures stereoscopically, and obtained the same result, but with a further effect, which was not apparent in the pictures now exhibited. In these the moon looked a black disc, standing away from the light coronal background, but in the Spanish photographs the moon was strongly projected in a globular form which he could not see here.

Mr. Ranyard doubted whether these were real stereoscopic effects, or produced by contrast of light and shade. He thought the motion was too small during the eclipse to produce pictures adapted for the stereoscope.

Dr. De la Rue said Mr. Ranyard was mistaken, as the motion in the time was quite sufficient.

Mr. Ranyard: There are so many ways of producing a stereoscopic effect that we should be quite sure on this point.

Mr. Proctor said no one would suspect him of wishing to invalidate evidence of the corona being solar, but he must say that, when combining Mr. Brothers' photographs, if placed in one way the moon appeared stereoscopic, and in another mode pseudoscopic. The argument from the stereoscopic effect was not a very strong one.

Mr. Brothers said, that when, twelve months ago, he exhibited a stereoscopic view of the eclipsed sun, he observed that the same thing could be done with diagrams of circles white and black. He

had considered his pictures as an evidence that the corona was a solar appendage, but a gentleman of eminence had denied this.

Mr. Brothers also exhibited the original negative of 1870, which had not before been shown at the Society, and an enlarged drawing from it. By careful examination, the corona, looked at by reflected light, extended 2⅓ diameters on one side of the sun.

The meeting then adjourned.

COMETS.

Professor Donati writes in the *Nazione* of March 4 in reference to many inquiries made of him respecting the announced collision of a comet with the earth in August next. He remarks, that at present, there are no comets visible, and that the appearance of large comets would be welcome, since there are recently discovered means of making new researches on them. He goes on to speak of the comet of Biela, due in August next, and inquires whether it may at some future time encouter the earth; and states, as the result of calculation, that this comet will be in 1872 always at a great distance from the earth. It will cross the earth's orbit on August 26, at which time it will be about 110,000,000 of geographical miles from the earth. This will be its nearest approach. On November 28, the earth will be situated where the comet was on August 26. There is therefore no danger of a collision with the earth. The professor then points out the extreme improbability (*il possibile degli impossibili*) of the earth colliding with *any* comet; or, if such a thing were to happen, the comet, he remarks, might probably become a satellite of the earth. He observes that in 1832, there was a similar report of a coming collision with Biela's comet, and that in spite of the assurances of astronomers, the general panic did not cease till dispelled by the actual falsification of the prophecy. Donati proceeds to comment on the very great probability, that the comet of Biela, which has not been seen since 1852, no longer exists, (the figures given above are on the contrary hypothesis.) In 1846, (as is well known), it appeared *double*, its two parts being 134,000 of geographical miles from each other; and in the apparition 1852 they were 200,000 geographical miles apart. The comet not being seen in 1858, was attributed to its nearness to the sun, as in 1839; but in 1866, when it should have been visible in dark night, the most powerful telescopes failed to discover it.

What then is become of the comet? has it vanished, or changed its course? That comets might be dissipated was long ago supposed by Kepler, who said that as the silk-worm wastes itself by spinning its cocoon, so comets may waste themselves and *die*, whilst they generate or *spin* their immeasurably long tails.

Besides Biela's comet, another discovered by Professor de Vico at Rome in 1844, which should return every five and half years, has not been seen since; yet this comet was much larger than Biela's, and did not, like the latter, show itself double. What may become of comets which disappear? Newton imagined that comets either fell into the sun, or scattered their matter through the celestial spaces, and thus served for aliment to the sun, and to the planets also. Nor, indeed, is this hypothesis of Newton's unreasonable, for although as I have remarked, the chance is very small that the comet of Biela should encounter the earth, I further observe that it may well be that its matter has already in part fallen, and is still falling upon our planet. . . . . In evidence of this, Donati

goes on to refer to the recent investigations of many learned men, and, in particular, of Professor Schiaparelli; who, on this account, obtained this year's gold medal of the R.A.S. of London. . . . . Professor D'Arrest has observed that the falling stars of the 5th December, radiate from the part of the heavens where the comet of Biela would appear, if in the beginning of that month it were to be in the neighbourhood of the earth. It appears then indubitable that this comet also forms part of a band (*armilla*) of cosmical corpuscules which revolve round the sun, and that in fact, it is only the largest of the said corpuscules. If this be the case, it would be subject to a mechanical action from those little bodies amongst which it is situated; and this action may have been the actual cause of the division into the two parts witnessed in 1846 and 1852. Similar divisions may have subsequently reduced the comet into fragments so small, that they only appear like falling stars, when in December, the earth approaches the band in which these little fragments move. Hence, as I remarked, perhaps the substance of the comet of Biela has already, in part, fallen to the earth, and may yet continue to fall upon it. But in all this there is nothing to cause apprehension, since the corpuscules that, whilst they are burning, appear to us as the falling stars, are in general consumed in the higher regions of the air, and only in very rare cases reach the surface of the earth under the form of the bodies called *aeroliths*. My supposition that Biela's comet may have been broken up into those little bodies which generate the falling stars, would acquire additional likelihood if, in August next, astronomers should not succeed in seeing this comet, as was the case in 1866. I have treated thus at length on the comet of Biela, because I have not been able to find any other astronomical indication that could in any way account for the general report of a coming collision between the earth and a comet in August next. Nevertheless, this common belief may perhaps be owing to reasons quite other than astronomical, inasmuch as error insinuates and spreads itself much more readily than truth.

Royal Observatory of Florence:
March 2, 1872.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

CUI BONO?

Sir,—May I be forgiven for saying that the letter of "R. E. J." on p. 71, is simply irrelevant to the question raised in the communication which you did me the honour to print in the January number of *The Astronomical Register*?

I believe that I appreciate simplicity of explanation at least as much as "R. E. J." can possibly do; but I confess that I utterly fail to find it in the Denning-Waite rigmarole which I criticised. I took no particular exception to the "ordinary sized marble" form of expression, although it did seem to be modelled upon the idea of magnitude entertained by the witness at the Old Bailey, who stated, on oath, that the stone thrown by the prisoner in the dock was "as big as a piece of chalk." It was the utter vagueness and incoherence of the entire statement (vagueness and

incoherence which deprived it of any scientific value whatever) that I found fault with.

Whether "R. E. J." has not enough mathematics to understand how the angular subtenso of a telescopic field can be $1^\circ 7' 42''$ (which he need scarcely be either a Cayley, Hirst, North, Sylvester, or Todhunter to do), or whether his confidence in the law of gravitation is so shaky as to preclude him from believing that the places of the planets can be calculated back for four thousand years, is a little wide of the mark. Perhaps I shall best point out what his admiration for Mr. Waite's form of exposition leads to by assuming, by way of illustration, that your correspondent were to wish to know when the meetings of the Royal Astronomical Society are held? Were the question put to me, I should answer, "On the second Friday in every month, from November to June inclusive." This, however, would be too bald, direct, and naked a statement for him; and, if he be consistent, he would prefer to be informed, *more Waitei*, that "The Society meets during two-thirds of the year, which must comprise either summer, autumn, and winter, or winter, spring, and summer; or else, perhaps, autumn, winter, and spring; unless, indeed, it should happen to be spring, summer, and autumn: and that the meetings take place either during the first or last halves of the months; and that, if they are not held either on Monday, Tuesday, Wednesday, or Thursday, they certainly are either on Friday or Saturday."

If any one will take the trouble to turn back to p. 287 of your last volume, I would really ask, with some confidence, whether this imaginary reply is a material exaggeration of the Denning-Waite mode of diction? and should really like to know whether this is the kind of mental pabulum that "R. E. J." craves, and is so desirous to be supplied with through the columns of *The Astronomical Register*? I am, sir, yours faithfully,

March 7, 1872. A SUBSCRIBER.

OBSERVING-SEAT.

Mr. Knobel writes to state that the *Handle* on the shaft of the Observing Seat, in our April Number, has been introduced in error by the Engraver, and has no real existence. There is no handle and none is necessary.

TRANSIT OF JUPITER'S FOURTH SATELLITE.

Sir,—On April 8 the satellite traversed a bright streak just *s* of belt 6, and was never more than one-fifth of Jupiter's diameter from his S. pole. Air very clear, and fairly steady. With 212 on 9-inch "With-Browning" IV. before ingress was small and brownish as usual. Before it was fully on the planet the advancing side became invisible, a circumstance I have never before observed. And it was actually beginning to be dark when only half its own diameter clear of the limb of Jupiter. When one diameter clear it was easily seen, and was larger, nearly equal in size to I. then just *f* Jupiter. At two diameters clear—still darker. At 9·20, when about 7″ from the nearest limb of the planet it was quite *black*. I could then see two slight projections, E. and W., and I thought between these, and completing a circle, there was a border with a slightly darker tint than the background. There was no perceptible change in the appearance of the satellite up to 10·20—past mid-transit, and near the noon of Jupiter, where we expect his surface is the most luminous. At 9·40 the *black* spot was less than I., which commenced its transit a few minutes before. I am, Sir, yours truly,

Bonner's Road, Victoria Park: T. H. BUFFHAM.

April 13, 1872.

TRANSIT OF JUPITER'S SATELLITES I. AND IV.

Last night these were on the disc together from 9-10 to 11-30 Local Mean Time.

There was this striking contrast between the two, that whereas I. was during the whole time utterly invisible, so that its place could not even be guessed at, IV. was seen during the whole time of observation, as a well-defined, almost entirely black spot, much smaller than I should have expected.

When first IV. was observed, it had accomplished one quarter of its journey across the disc, and it was watched till within the same distance of its egress.

During the first half of its journey it appeared both blacker and better defined than during the latter, the air being equally good the whole time. This transit took place along the S. edge of a dark belt.

My friend, Mr. Charles Burton, drew attention to the fact that the dark spot representing IV. was not round, but decidedly elongated in the direction of the belt during the whole time of observation. In this I concurred. Powers used were 150 and 400 on my 7½-inch Alian Clarke.

On 31st March, I observed transit of III. also as a dark body smaller than expected.

On 9th March, I observed a transit of I., on which occasion also it was to me utterly invisible.

WENTWORTH ERCK.

Sherrington Bray: April 9, 1872.

Addendum to note by Wentworth Erck, Esq., on Transit of Jupiter's Satellites I. and IV. of 8th April, 1872.

The satellite's following extremity was sharper than the preceding, 11-30 L. M. T., power 400.

Loughlinstown: April 10, 1872. CHAS. E. BURTON.

Note on Transit of IV. Dec. 30, 1871.

IV. When first seen, taken for a satellite shadow on account of its blackness.

I could not satisfy myself that IV. was not circular. When first seen, and not more perhaps than its own diameter from the planet's limb, the satellite was extremely dark, possibly as dark as when near mid-transit. I once or twice thought that the satellite was in contact with a bright crescent on its s. p. limb. (This bright crescent was, very possibly, part of a white spot on the planet.)

At 12-20 L. M. T., the satellite was in close contact with the N. edge of Gledhill, No. 6. High wind, definition fairly good, at times bearing 228.

Instrument used, a 7-inch silvered glass Newtonian, equatorially mounted, with R. A. driver.

CHARLES E. BURTON, late of the Observatory, Parsonstown; and Member of Eclipse Expedition, 1870.

PROCTOR'S STAR CHART.

Sir,—It would be interesting to hear from Mr. Proctor some account of the peculiarities shown by his star chart of the northern hemisphere. In the copy I have—and doubtless all are the same—there are some

features which, I suppose, are due to accident in drawing the original. The chief of these is the manifest tendency of the stars to a concentric arrangement round the pole. For example, there appear to be rich regions in Auriga in dec. 40° and 45°, and in Cygnus in 53°, and blank regions in Cassiopeia in dec. 51°, and Camelopardus in 65°. There is also a slight radiation from the pole, especially between 0h. and 2h. in R.A. The texture of the map, as Mr. Proctor points out, is very remarkable, showing a strong tendency of the stars to arrange themselves in minute lines, so forming a network. I suppose this is correctly drawn.

I am,

Yours, &c.,

T. W. BACKHOUSE.

Sunderland : Feb. 14, 1872.

FINE METEORS.

Sir,—An unusually magnificent meteor was observed here on March 31. The following positions, &c., may be considered pretty accurate. First appearance, R. A., 6h. 40m., Decl. 33° ; time, 12h. 9m. It first presented no extraordinary appearance, but soon became much larger and brighter, illuminating the whole of that part of the sky. Its colour was at first white, then red, then an intense purple. It was still rapidly increasing in size and brilliancy, when, unfortunately, a house cut off all further view of it. Its position then was about R. A., 9h. 0m., and Decl. 0°. Duration of visibility, probably not more than one second. It left no train.

Between 11h. 40m., and 13h. only two others were seen. These, however, were ordinary "shooting stars :" the direction of their motion was from the same radiant point, but towards α Tauri.

Yours faithfully,

Barnsbury, N. : April 4, 1872. F. W. LEVANDER.

Sir,—A fine meteor, with a long and persistent train, was observed here at 7h. 55m., G. M. T. on the evening of March 26. It proceeded from about midway between η *Ursæ Majoris* and γ *Bootis*, and disappeared very near to β Cephei. Its colour was orange, and it seemed to be at least equal to Jupiter in brightness.

I remain, yours faithfully,

Bedford : March 28. THOS. G. E. ELGER.

LINNE.

Dear Sir,—I had a very fine view of Linne on the 15th of March last, about 9h. G. M. T. I am induced to communicate this, as I think I saw the crater quite as distinctly and sharply defined, though not quite so large, as it is represented in Mr. Carpenter's beautiful drawing in No. 70 of the *Register*, October, 1868. This drawing represents the appearance in the Greenwich Equatorial of 12¾ inches aperture on June 26, 1868, at 10h. G. M. T. The crater arose out of the hazy white cloud, as a low conical hill, with exactly the appearance depicted in Mr. Carpenter's drawing. By a fortunate coincidence, the moon's age was almost precisely the same in both cases, being in Mr. Carpenter's 6·3 days old, and

in mine 6·37 days. The instrument used was a very fine refractor of 8 inches aperture, by Cooke and Sons, recently erected here, with a magnifying power of 550. The definition was exquisite, as I first distinctly saw the minute crater with so low a power as 135.

Yours truly, GEORGE HUNT.

Chad Road, Edgbaston: April 13, 1872.

THE HOLLIS OBSERVING-SEAT.

Sir,—Will you allow me to call the attention of your readers to the "Hollis Observing Seat" recently advertised in this paper. I find it a most valuable addition to my 3in. Achromatic: indeed for use with small telescopes of this sort, it is really the best I have yet seen, and its price is almost nominal.

It is only suited to direct-vision Telescopes, but for them it is invaluable for besides being very comfortable, it affords a steady support for the head of the observer. OLIVER J. LODGE.

Errata in No. 112, page 90, 12th line from bottom, for *fitted* read *filled*; page 98, line 28, for OF THE ROYAL, read AND

Errata, page 94, at commencement, read, I have *not* been enabled; 10th line, read, the *shadow seemed* smaller and darker.

SPIDER-WEBS IN TELESCOPES.

Sir,—The remarks of Capt. Noble induce the thought that these little creatures have been unusually active of late. Having suspected a diminution in the light given by a 4-inch object glass, I brought the matter to test one evening before daylight was quite gone, by exchanging an eye-piece from it to a smaller instrument, when my suspicions were confirmed, the smaller giving by far the brighter image of the moon. An inspection of the tube was then made, by looking up at the object-glass without the intervention of an eye-piece. There was nothing remarkable in the view, but a sort of watered silk appearance over the object-glass; this was taken out and cleaned, and I was about to replace it, when happily I thought of looking through the tube alone; there still was the same appearance, which, on closer inspection, proved to be a very fine web, spun in the middle of the tube, and covered with fine dust. This was soon removed, at the same time pitying the poor spider in its effort to exist by fly catching in such a barren place.

It is not only in astronomical matters that the cobwebs and dust of earth obscure our view of heavenly things, but the practical lesson for those who delight to use these tubes armed with their wonder-working glasses, is sometimes to take a peep through them without their aid.

Yours truly,

3, Circus Road, St. John's Wood. NATHL. E. GREEN.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MAY, 1872.

By W. R. BIRT, F.R.A.S., F.M.S.

By employing the period of similar phase of 442 days 23 hours, between February 21, 1871, and May 9, 1872, we can use the list of lunar objects inserted on p. 48 of Vol. IX., supplement ☾ — ☉, 1871, February 21,

= 150° 37′, diminishing to 73° 5′ on the 28th. 1872, May 9, supplement ☾ — ☉ = 152° 7′, May 16 = 74° 59′. These quantities being accordant as to nearness of value with those given in our April number, the list for February, 1871, will be available for May, 1872.

On the 21st April, 1871 (see vol. IX., p. 102), the value of supplement ☾ — ☉ was 155° 38′ diminishiug to 78° 17′ on the 28th, and still further to 53° 45′ on the 30th. The lists of February and April, 1871, may consequently be combined for indicating suitable objects for observation in May, 1872.

Libration will in a measure affect the positions of the objects given as regards the terminator. It is a matter of congratulation that in addition to the position of the terminator, the *true* method of expressing the moon's libration is given in the number for April, 1872, viz., the latitude and longitude of the centre of the visible disk, as seen from the centre of the earth. At the times of first and last quarter, when supplement ☾ — ☉ = 90°, the objects situated near the terminator are as follows: between the first meridian and 5° west longitude, and the equator and 5° north latitude, *Triesnecker*, *Rhæticus*, *Murchison*, and the objects in my catalogue of area I. A alpha. Between the same longitudes and the equator and 5° south latitude, *Reaumur*, and the objects of IV. A alpha of my map, on the eastern side within the same limits, *Pallas* and *Herschel*. Some of these by the effect of libration may be on the night side and invisible when the moon is in her first or last quarter.

The following may be added to the list of February, 1871: Feb. 24, Römer, Maraldi. Feb 28, Pico.

Fifth Zone of objects from North to South.

Geminus (*a*), Buckhardt (*b*), Cleomedes, Mare Crisium, western part, Azoul, Firmicus, Apollonius, Langrenus, Vendelinus, Petavius (*c*).

This zone contains some of the finest formations on the western hemisphere. From their proximity to the limb they are, however, comparatively but little known. Beyond the striking features manifested by the large formations Langrenus and Petavius, the details have been but partially studied. The early spring months is the best season for observing them, and every advantage should be taken for this purpose when the moon is from two to five days old.

(*a*) The *semi-obliteration* of this crater, as the sun attains a considerable altitude, is an interesting subject for study during the progress of the luni-solar day.
(*b*) Notice the curious superposition of a recent crater on a more ancient one.
(*c*) An enlarged drawing of Petavius by Mädler, with the Dorpach refractor, is given in the new edition of B. & M.'s map.

ECLIPSE OF THE MOON.

A partial eclipse of the moon, visible at Greenwich, will take place on the 22nd of May.

		h.	m.
First contact with the penumbra	...	9	9·8
First contact with the shadow ...	...	10	40·9
Middle of the eclipse	...	11	18·2
Last contact with the shadow ...	...	11	55·5
Last contact with the penumbra	...	13	26·6

Magnitude of the eclipse (moon's diameter = 1) 0·116.

ASTRONOMICAL OCCURRENCES FOR MAY, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Jupiter
Wed	1		Sidereal Time at Mean Noon, 2h. 38m. 52·87s.	1st Tr. I. 2nd Sh. E. 1st Sh. I. 1st Tr. E.	9 52 10 40 11 5 12 11	— 5 0·6
Thur	2			1st Ec. R.	10 35	4 57·2
Fri	3		Sun's Meridian Passage, 3m. 19·44s. before Mean Noon	1st Sh. E. 4th Oc. D.	7 54 12 28	4 53·8
Sat	4					4 50·5
Sun	5	8 48 14 44	Conjunction of Moon and Venus, 2° 30′ N. Conjunction of Moon and Mercury 0° 51′ N.			4 47·1
Mon	6			3rd Tr. E. 3rd Sh. I.	9 13 10 30	4 43·8
Tues	7	1 18·7 5 9 22 52	● New Moon Conjunction of Moon and Mars 2° 13′ N. Conjunction of Venus and Mercury, 1° 59′ S.			4 40·4
Wed	8			2nd Tr. I. 2nd Sh. I. 2nd Tr. E.	8 1 10 21 11 50	4 37·1
Thur	9			1st Oc. D. 1st Ec. R.	9 2 12 30 28	4 33·8
Fri	10			2nd Ec. R. 1st Tr. E. 1st Sh. E.	8 3 42 8 39 9 49	4 30·5
Sat	11					Moon. 3 12·5
Sun	12	6 59 8 10 13 54 19 58 3 50	Occultation of B.A.C. 2514 (6½) Reappearance of ditto Conjunction of Moon and Jupiter, 3° 1′ S. Conjunction of Moon and Uranus, 3° 12′ S. Conjunction of Mars and Sun	4th Sh. I.	7 54	4 2·8
Mon	13			3rd Tr. I.	9 55	4 52·1
Tues	14					5 39·9
Wed	15	4 5·6	☽ Moon's First Quarter Illuminated portion of disc of Venus 0·958 Illuminated portion of disc of Mars 1·000	1st Tr. I.	10 46	6 26·0
Thur	16		Saturn's Ring: Major Axis=39·81″ Minor Axis=15·55″	1st Oc. D.	11 1	7 10·8

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
				3rd Ec. R.	8 6 37	Moon.
			Sidereal time at Mean Noon, 3h. 41m. 57·77s.	1st Tr. I.	8 18	—
Fri	17	8 5	Occultation of ν Virginis (4½)	1st Sh. I.	9 24	7 54·9
				1st Tr. E.	10 37	
		9 20	Reappearance of ditto	1st Ec. R.	10 38 30	
				1st Sh. E.	11 44	
Sat	18			1st Ec. R.	8 54 40	8 39·1
			Sun's Meridian Passage, 3m. 45·06s before Mean Noon			
		9 15	Occultation of 65 Virginis (6)			
Sun	19	10 25	Reappearance of ditto			9 24·5
		10 8	Occultation of 66 Virginis (6)			
		11 20	Reappearance of ditto			
		8 28	Occultation of κ Virginis (4½)			
Mon	20	9 8	Reappearance of ditto	4th Oc. D.	7 51	10 12·3
		14 54	Occultation of 2 Libræ (6)			
Tues	21	9 15	Near approach of ν^1 Libræ (6)			11 3·6
		11 8·3	○ Full Moon			
			Eclipse of the Moon			
		9 26	Occultation of ω^1 Scorpii (4)			
		10 34	Reappearance of ditto			
Wed	22	9 52	Occultation of ω^2 Scorpii (4½)			11 59·3
		10 59	Reappearance of ditto			
		13 13	Occultation of B.A.C. 5395 (6)			
		14 24	Reappearance of ditto			
Thur	23	14 26	Near approach of 39 Ophiuchi (6)			12 59·4
		16 20	Occultation of θ Ophiuchi (3½)			
				3rd Oc. R.	7 57	Arcturus.
				2nd Oc. D.	8 18	
Fri	24			3rd Ec. D.	8 37 44	9 58·6
				1st Tr. I.	10 16	
				1st Sh. I.	11 15	
Sat	25	17 34	Conjunction of Moon and Saturn 3° 33′ N.	1st Ec. R.	10 50 3	9 54·7
Sun	26			1st Sh. E.	8 7	9 50·7
Mon	27	14 49	Near approach of 37 Capricorni			9 46·8
Tues	28					9 42·9
Wed	29	2 12·4	☾ Moon's Last Quarter			9 38·9
Thur	30					9 35·0
Fri	31			3rd Oc. D.	8 44	9 31·1
				2nd Oc. D.	11 2	
JUNE. Sat	1			1st Oc. D.	9 31	9 27·1

MOON.

LIBRATION. Selenographic long. and lat. of the point on the moon's surface, which has the earth's centre in the zenith.

TERMINATOR. Selenographic longitudes of the points in latitude 60° N., 0° and 60° S., when the sun's centre rises or sets.

Greenwich, Midnight. 1872.	long.	lat.	60° N.	0°	60° S.
				SUNSET.	
			°	°	°
May 1	+5·8	+6·6	−19·0	−17·5	−16·1
2	4·4	6·6	31·2	29·8	28·4
3	+4·9	+6·4	−43·3	−42·0	−40·6
				SUNRISE.	
9	+2·5	−0·5	+65·7	+64·6	+63·5
10	1·4	2·0	53·4	52·3	51·3
11	+0·1	3·3	41·1	40·1	39·1
12	−1·3	4·4	28·9	27·9	27·0
13	2·6	5·4	16·7	15·8	14·8
14	3·9	6·1	+ 4·4	+ 3·5	+ 2·6
15	5·0	6·6	− 7·9	− 8·8	− 9·6
16	5·8	6·8	20·2	21·0	21·8
17	6·4	6·7	32·4	33·2	33·9
18	6·6	6·2	44·6	45·3	46·0
19	6·4	5·4	56·8	57·5	58·1
20	5·8	4·2	69·1	69·7	70·3
21	4·9	2·8	−81·4	−81·9	−82·5
22	3·6	−1·2		SUNSET.	
23	2·2	+0·5	+73·2	+73·7	+74·1
24	−0·6	2·3	61·1	61·5	61·9
25	+1·0	3·8	49·0	49·3	49·7
26	2·5	5·1	36·8	37·1	37·4
27	3·8	6·1	24·7	24·9	25·2
28	4·8	6·7	12·5	12·7	12·9
29	5·6	6·8	+0·3	+0·5	+ 0·7
30	6·1	6·6	−11·9	−11·7	−11·6
31	+6·2	+6·0	−24·1	−24·0	−23·9

SUN.

Greenwich, Noon. 1872.	Heliographical longitude of the centre of		Heliographical latitude the sun's disc.	Angle of position of the sun's axis.
	°		°	°
May 1	56·61	121+ δ ξ	−3·90	335·85
2	69·85		3·79	336·04
3	83·08		3·69	336·23
4	96·32		3·58	336·44
5	109·55	+125 δ ξ	−3·47	336·65
6	122·79		3·37	336·87
7	136·03		3·26	337·09
8	149·26		3·15	337·32
9	162·50		3·04	337·56
10	175·74		2·93	337·81
11	188·98		2·81	338·06

12	...	202·22	+132 δ ξ	...	—2·70	...	338·32
13	...	215·47		...	2·59	...	338·58
14	...	228·71		...	2·47	...	338·86
15	...	241·95		...	2·36	...	339·14
16	...	255·19		...	2·24	...	339·42
17	...	268·44		...	2·13	...	339·71
18	...	281·68		...	2·01	...	340·01
19	...	294·93	+139 δ ξ	...	—1·90	...	340·32
20	...	308·17		...	1·78	...	340·63
21	...	321·42		...	1·66	...	340·95
22	...	334·66		...	1·54	...	341·27
23	...	347·91		...	1·42	...	341·60
24	...	1·16		...	1·30	...	341·93
25	...	14·41		...	1·19	...	342·27
26	...	27·66	+146 δ ξ	...	—1·07	...	342·62
27	...	40·90		...	0·95	...	342·97
28	...	54·15		...	0·83	...	343·33
29	...	67·40		...	0·71	...	343·69
30	...	80·65		...	0·58	...	344·06
31	...	93·90	+151 δ ξ	...	—0·46	...	344·43

THE PLANETS FOR MAY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	1 54 55	+10 42	11″·5	23 12·2
	15th	2 3 22	+ 8 58½	9″·2	22 25·6
Venus ...	1st	1 24 37	+ 7 14½	10″·5	22 42·0
	15th	2 29 39	+13 24	10″·2	22 51·8
Jupiter ...	1st	7 40 15	+21 59	33″·7	5 0·6
	15th	7 48 48	+21 38	32″·3	4 14·0
Saturn ...	1st	19 31 45	—21 28½	15″·6	16 50·1
	15th	19 30 54	—21 31	16″·0	15 54·2
Uranus ...	4th	7 59 4	+21 12½	4″·0	5 7·5
	16th	8 0 38	+21 8	4·0	4 21·9

Mercury is not in a good position for observation, rising about a quarter of an hour before the sun at the beginning of the month, the interval increasing to about three quarters of an hour at the end.

Venus rises about half an hour before the sun.

Jupiter is still well situated for observation; towards the end of the month he sets before midnight.

Saturn towards the end of the month rises before midnight, and will be visible for the rest of the night, but too low to be well observed.

Uranus is still visible.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To April, 1872.
Holden, Rev. W. T.

To June, 1872.
Hendry, W.

To July, 1872.
Blacklock, A. W.

To Dec. 1872.
Green, G. N.
Parnell, J.
Waldegrave, Hon. H. N.
Weldon, Mrs.

To March, 1873.
Elger, J. G. E.

To June, 1873.
Tupman, Capt.

TO CORRESPONDENTS.

NOTICE.—It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 114. JUNE. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Seventh Meeting, May 10th, 1872.

Professor Arthur Cayley, F.R.S., *President*, in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last meeting were read and confirmed.

Thirty-three presents (chiefly serials) were announced and the thanks of the Society given to the respective donors.

The following papers were announced and partly read:

Observations of Planet 120: by Dr. Peters.

The places given extended from April 11 to 19. It appeared that Dr. Peters made an independent discovery of the planet on the 11th, in America, one day after it had been found by M. Borelly, at Marseilles.

Elements of Minor Planet 119: by M. Pechale.

The results arrived at from four observations are as follows:—

Epoch 1872. April 28·5, Mean Time, Berlin.

		°	′	″
M	...	164	2	4
π	...	36	34	33
Ascending Node		203	39	38
ι	...	6	30	31
ϕ	...	8	3	11
μ	...		862″·08	
Log. a			0·40964	

Eclipse of Jupiter's Third Satellite, April 11, 1872: by Capt. Noble.

This was only 2m. 19·9s. after the *Nautical Almanack* time, showing, as Capt. Noble remarked, a great improvement either in the satellite or the tables.

Mr. Dunkin said the last eclipse of the fourth satellite differed only 4m. from the prediction.

Occultations of Stars by the Moon: by Capt. Noble.

The star B.A.C. 3579 disappeared at 9h. 48m. 37·2s. L.S.T. = 7h. 59m. 40·8s. L.M.T., and reappeared at 10h. 6m. 19·5s. L.S.T., = 9h. 17m. 10·4s. L.M.T.

The occultation of ι Leonis on the same night was partially observed.

On errors in Vlacq's Table of Ten figure logarithms of Numbers: by Mr. J. L. Glaisher.

The author read an interesting account of his inquiries on this subject, from which it appeared that most of the tables in use were reprints from Vlacq's, and had the same errors. He had collated all the tables of errata, and compiled a complete list, about 700 in number, out of the 100,000 logarithms in the table, but at least half of them were quite unimportant. He also asked for any information as to the life of Vlacq.

On the recent Solar Eclipse: by Col. Tennant.

The author in presenting a lengthy report of the observations made by his party, said that there was little of it which could be condensed into a conversational narrative, the principal results being the photographs which he exhibited. These were six in number, but one was imperfect from the clock stopping, and one had been damaged. The remaining four he hoped would be printed. Personally he had observed with a 6-inch telescope, stopped down to about 2½ inches, so as to secure a large field. Capt. Herschel's telescope, fitted with a spectroscope, was guided by the same movement as his, so that they might always observe the same thing. The result of the speaker's observations was that he was convinced every part of the corona was a solar phenomenon, the rifts and rays being all connected with the prominences. In the spectroscope no change from former results was noticed. The usual allowance of lines was seen. As the sun went out the number of bright lines increased, but the exact moment of extinction was lost, so that the complete reversal of the Fraunhofer lines was not witnessed. The lower part of the light, close to the moon's limb, appeared to consist of masses of vapours which effect the absorption, producing the dark lines. The bright lines in this stratum appeared in such enormous numbers that it was useless to attempt to identify them. They were seen on a somewhat light ground, it not being likely that the back ground could be entirely black. Some were noted, but they came out so rapidly close to the dark limb of the moon, that they could neither be counted or mapped in the two or three seconds available. The photographs were, he thought, as good as any that had ever been

taken, at any rate, as to the three first, and he said this after having seen those taken by Mr. Davis (Lord Lindsay's assistant), at Bekul. One thing was absolutely certain, viz.: that the corona was connected with the prominences to a certain extent. (This was illustrated by a sketch.) The place immediately behind a prominence was comparatively dark. The rifts seem to radiate from the sides of the conical prominences. The photographs gave a very fair representation of the corona, as seen with the eye, but, of course, did not show the light extending so far as the eye alone could trace it. One portion was seen to extend quite a radius of the moon from the limb, but in the photographs it looked from 8′ to 12′ only. The original negatives, which were at Greenwich, shewed more detail than the glass positives exhibited. The corona decreased so rapidly in luminosity from the sun's edge, that the outer portion was very faint. In the reports of the 1870 eclipse it had been remarked that near the sun there was a ring of uniform brightness for a certain distance, beyond which the light degraded rapidly, but nothing of the kind could be seen on the last occasion. He was satisfied the diminution of the light of the corona was gradual in this eclipse, although there was a glare extending for 3′ or 4′ from the prominences. His party were extremely lucky to have done so much, for after several days of fine weather it rained heavily the night before the eclipse, which caused them to be enveloped in a thin mist next morning, through which the observations were made. Their elevation was 8,600 feet above the sea, and the air was bitterly cold and damp.

In answer to various questions Col. Tennant further stated that it was most difficult to notice the coming out of the bright lines, as they appeared by fits and starts, and there was always a dim coloured spectrum behind them.

Mr. Ranyard enquired whether all the lines came out at the same level, or whether the most marked ones were not higher than the others?

Col. Tennant said that he was not the spectroscope observer, and, therefore, could not answer this question, but as everything seen occurred in three or four seconds, he thought it unlikely this difference could be noted.

Mr. Ranyard: Perhaps I should rather have said different times than levels.

Col. Tennant: There certainly must have been a difference in times, but the succession was so rapid that lines could not be identified.

Mr. Ranyard: Was the spectroscope an integrating one?

Col. Tennant: No. It was an ordinary slit spectroscope. We made one of the kind referred to, but it broke down altogether, and, I think, we got on quite as well with the other.

Mr. Brett: If Col. Tennant, in speaking of a ring of uniform brightness in the corona nearest the moon's limb, refers to my observations in Sicily, I can only say that the appearance was most decided, but I only saw it just before totality.

Mr. Elger suggested that the mist spoken of by Col. Tennant might have diminished the light of this zone.

Col. Tennant: The mist was only a slight dampness, and looked as if we could almost push the telescope through it in a few feet.

Dr. De la Rue wished to remark on the great value of the photographs exhibited by Col. Tennant, which as far as his opportunities of comparison went excelled all he had ever seen. There was about them an amount of precision and definition very remarkable, which was quite conclusive evidence that the phenomena depicted were objective and belonged to the sun. As in 1860 the speaker's photographs proved that the prominences belonged to the sun, so Col. Tennant's now did the same for the corona. By looking at the connection of the rifts and prominences it would be seen as the moon moved, and covered and uncovered them, they kept together and occupied the same position in the last picture as in the first.

It would be very interesting to compare these photographs with those taken by Lord Lindsay's operator at a distance, and see if the principal points preserved the same positions in both. In 1860 the speaker was able to compare his pictures with those taken by Secchi at a distance, having an absolute difference of eight minutes of time, and proved the prominences were at the same angles. It was important to do this now, and ascertain if, apart from any change in the prominences during the time, they were seen in the same places.

Capt. Noble said that when the thanks of the meeting were given to Col. Tennant they would be the more hearty, as he had been the first of the observers who had come forward to remove the disgraceful state of ignorance in which the society had been kept by others, who had arrived here long ago. He then noticed that, whereas Col. Tennant spoke of a dark background to the prominences, observers, in 1870, at Gibraltar, saw just the reverse; one of the officers having told the speaker that wherever there were red mountains the corona extended further in those directions, and as this statement was made by a person having no preconceived theory, it was of considerable weight.

Col. Tennant said that two sketches made by Capt. Morant fully confirmed his statement, as in these the rifts seemed to diverge from the sides of the prominences, but he doubted if this were the case generally, as the corona was probably produced by jets from the prominences.

Capt. Noble enquired whether Capt. Tupman was present, and finding he was not, said his object had been to ask Capt. Tupman to read a telegram he had received immediately after the eclipse from the chief of the expedition, stating that the corona "was almost entirely atmospheric." It seemed, however, that the gentleman referred to had afterwards changed his opinion.

Rev. F. Howlett: Is there not a special difficulty in supposing the rifts to be connected with the prominences, when it is remembered that the latter are mere projections of very little thickness, but the rifts must extend entirely through the solar atmosphere?

Mr. Proctor thought the difficulty would disappear on considering that the corona could not be a shell surrounding the sun, but flatter and flameshaped. He had once suggested that its form might be produced by the revolution of a double hyperbola round the sun's axis, and the point started corroborated his view. We were driven to conceive of the corona as like cone-shaped flames, as anything like an atmosphere with rifts through it was quite inadmissible.

Dr. Huggins enquired whether any polariscope observations were made?

Col. Tennant said he meant to have done this, but the apparatus did not arrive in time. He indeed had a *Savart*, but found no time to use it. Dr. Broughton, who examined the vertical plane of the corona only, saw strong and unmistakable radial polarisation, and it was strong also where the corona was not visible. This must have been from some peculiar cause. In 1868 the polarisation was plain.

Dr. De la Rue had been going to ask the same question as Dr. Huggins, because there was another way of accounting for the rifts. The prominences gave less light than the photosphere, and, therefore, shut off light, leaving less to fall upon the corona.

Mr. Elger: In Sicily the drawings made, in 1870, by Professor Watson and Signor Carlentini, compared with those made at Gibraltar, showed that the rifts corresponded in being between the prominences, and that the corona was strongest over the prominences.

Mr. Ranyard made some further remarks, and a drawing on the black board to explain his views as to the black lines or sticks in the corona.

Col. Tennant said he doubted if we had data enough at present to discuss the subject further, but he would point out that in the photographs (he did not say always but generally), there were under the black radiations indications of faint prominences.

These were, of course, black divisions between brighter parts of the corona—not things of themselves but simply absence of light.

Mr. Ranyard: In Lord Lindsay's pictures there are four black sticks very well marked.

Col. Tennant said he had not before seen Lord Lindsay's pictures, but looking at them now he could see the prominences under these black lines.

After some further conversation as to the connection between the rifts and the sun's poles, Col. Tennant was asked how long the plates were exposed, and replied that the times varied very much. That originally it had been intended to act upon a system, but under the circumstances of the weather the operator had very wisely given this up. The exposures were 15, 10, 8, 5, and 6 seconds, and he thought the short exposure was as good as the longer.

Mr. Ranyard asked whether the outer corona could be seen in the original negatives, or whether it had disappeared in varnishing?

Col. Tennant: The negatives are at Greenwich and are not varnished, but I can see no more of the corona than in these positives.

Mr. Carrington enquired how the direction of the sun's axis had been ascertained?

Mr. Ranyard: By taking plates before the sun was covered, and using your formula, founded on data given by the direction of the spots.

On an Altazimuth Mounting for Telescopes, especially adapted for the use of Observers who have no permanent observatory: by Mr. J. Brett.

This telescope was exhibited and described by the inventor, but without an engraving will hardly be understood. When closed, nothing is visible but a rectangular polished mahogany box standing upright. This is the tube of a $9\frac{1}{4}$ inch silvered glass reflector, one side of which tube opens and discloses two legs made of brass tubes hinged in the middle, which, upon touching the ground, bend, and form with the tube a triangle, the telescope being the hypotheneuse. The lid of the tube opens back, and forms the nose-piece for the eye-pieces which are stowed away on the inside of another little door in the tube. The legs terminate in long steel screws, by which motion is given to the wooden tube. The speculum end resting on casters, quick motion in azimuth is obtained by moving the instrument bodily, and slow motion by one of the screws. Quick motion in altitude is given by drawing out the legs, and slow motion by one of the screws. The brass tubes contain springs to counterpoise the weight of the

telescope. There is another door near the bottom of the tube to uncover the speculum, and the middle of the upper side is made of cane lattice work to avoid air currents in the tube. The mounting would do for any kind of telescope, but it is easy to get steady stands for refractors, and Mr. Brett thought for the Newtonian reflector this was both steady and portable.

Mr. Lassell enquired whether the telescope could be lowered to the horizon; and the President asked its weight?

Mr. Browning, who made the mounting, said the whole instrument weighed less than 40 lbs., and could be easily carried.

Mr. Brett showed that the telescope could be set to a very low altitude, and that, if the horizon were wanted, the speculum end could be set on a bench, and the required position obtained.

Mr. Dunkin enquired if the zenith could be observed?

Mr. Brett: Yes; but in that position the action of the screws is very slow.

Mr. Browning: I have worked with this telescope, and find it very fairly steady, and, as compared with most portable stands, it is *very* steady. It is also easy to follow a star with an almost equatorial motion by working both screws at once.

Dr. De la Rue said that the Society was much indebted to Mr. Brett for exhibiting so very portable and efficient an instrument, but he (Mr. B.) was under a misapprehension if he thought there was any difficulty in mounting large reflectors equatorially. To say nothing of Mr. Lassell's and the speaker's own instruments, the 4 foot reflector made by Mr. Grubb, of Dublin, was so beautifully mounted that a boy of fourteen could move it in any direction, and reverse the axis. With respect to air currents in the tube, he did not think the lattice work would get over that difficulty. He had found that sort of structure acted like a solid panel. There must be hardly any tube at all to prevent these currents.

Mr. Lassell: The whole of the lower side is open where the legs come out and retire, and I think there could hardly be any currents in this state of things.

Mr. Brett: The top is solid to keep the dew off.

Dr. De la Rue: I tried to make the tube of my telescope of lattice work, but was obliged to resort to a complete skeleton of 4 pipes only.

Mr. Lassell said such a skeleton mode of construction had the inconvenience of constituting a sort of Æolian harp in strong winds. He did not mean to say vibrations were audible to the ear, but they were to the eye.

In answer to a question, Mr. Brett stated that the speculum was bedded on felt, with a little play around for expansion.

Mr. Dunkin: The instrument appears very portable; is it intended for travelling?

Mr. Brett: That is one object, but readiness at home was equally aimed at. I can carry it out of doors and get it to work in five minutes.

Mr. Lassell: It appears to be a powerful instrument in a very small compass, and possessing great portability.

Note on the Discovery of Saturn's Second Satellite: by Mr. Proctor.

This paper referred to the discovery, by Sir W. Herschel, of the second satellite in order of distance from the planet, and was partly designed to elicit information on the subject. It has been usually stated that this discovery was the first fruit of the use of the 40-foot telescope, and made on the day that instrument was completed, but Dr. Robinson had denied this, and Sir J. Herschel had subsequently stated that he found, from a private memorandum of his father's, that the satellite had been discovered with a 20-foot telescope.

This has generally be enconsidered as final, but Mr. Proctor, having referred to Sir W. Herschel's papers, is by no means satisfied with the usually accepted result, and finds in the *Philosophical Transactions* statements which leave the whole question of the discovery open to further evidence, as there are passages from which it may be inferred that it was a result of the use of the 40-foot reflector. It is usually stated that the discovery was made in August, 1789, and the mention in the private journal that this was done with the 20-foot telescope would—*a priori*—be assumed to be correct, but a private and hurried entry is often wrong, while a public statement, which would necessarily be carefully read and revised, may be more correct than a mere formal entry. There is another mention of this discovery in the *Philosophical Transactions* for 1790, and again at the end of a list of nebulæ there is a note of the discovery of the sixth satellite, and a promise that an account of this discovery, *with the 40-foot telescope,* shall be read at the next meeting. The discovery was in August, and this was printed in November. Another piece of evidence is that Struve was presented with a copy of all Sir W. Herschel's papers, which must have been read over and annotated by their author, and Struve has stated that the 40-foot instrument led to the discovery.

Note on the Densities of Jupiter's Satellites: by Mr. Proctor.

These densities are uniformly quoted in our text books as very small, and generally in company with La Place's masses. Thus, in *Lardner's Hand Book,* they are stated to be lower in density than Jupiter himself, which makes them lighter than water.

Authors and compilers should not take these things for granted but examine them and give the authority for them. As a matter of fact the second satellite is about 2,000 miles in diameter, or a 40th of that of Jupiter. If it be of the same density as the planet, the mass would be 0.0000156, but it is 0,0000232, or nearly twice as much, so that the density is twice that of water. All the four moons are in the same category, and, therefore, even if the real diameter of Jupiter be not overrated, it indicates an approach in density to that of our own satellite.

Mr. Lassell remarked that the controversy between Dr. Robinson and Sir J. Herschel as to the telescope used in the discovery of Enceladus occurred in 1843, and was carried on by letters in the *Athenæum.* He recommended that this correspondence should be referred to. He thought Dr. Robinson was probably right, but did not admire his animus. With respect to the papers of Sir W. Herschel in the *Philosophical Transactions,* the author rarely mentions the instrument with which he made any observations. He says that the 40-foot telescope was completed on a certain day, on which day the sixth satellite was discovered, but he does not say it was with that telescope.

On Astronomical Units: by Col. De Crespigny.

On the Nutoscope, an Instrument for shewing Precession: by Professor Zenger.

On Tables of Jupiter's Satellites: by Mr. Maguire.

On the Value of the Stereoscope as applied to the examination of Eclipse Photographs: by Mr. Ranyard.

At the last meeting the combination of different photographs taken during a solar eclipse had been suggested as a means of proving that the corona is a solar appendage, and if such evidence could be relied on, its importance could not be exaggerated. The author, therefore, wished to examine how far such appearances could be trusted. The point is whether the rays are bodies of three dimensions, and upon this question shading has great influence. Artists constantly, by shading two dimensions, give an effect of solidity due to three measures, but this does not prove that there is a real parallax. During the discussion of a microscopical question, Mr. Beck photographed a glass tumbler covered with knobs, and the picture, if looked at one way, appeared in relief, and in another, pseudoscopic. So the eclipse streamers, if shaded, might look solid. We cannot be too careful in the use of lenses. Even a single convex lens, used to look at pictures of flowers, &c., will give a considerable effect of relief. In 1860, the photographs showed that the moon was passing over the prominences, and thus proved a real parallax; but the distant corona being further from the limb, and destitute of points for

measurement, cannot be treated in this manner. The prominences can thus be shown to be behind the moon, and perhaps certain details of the corona might be measured in the same manner, but not the more distant and faint parts. As regards the value of the stereoscope in comparing photographs taken at a distance from one another, such as Lord Lindsay's and Col. Tennant's, it was remarkable to see how the light and shade were increased by superposing, and the stereoscopic effect increased in proportion. As to the moon appearing globular in such combined pictures, no one had ever described the moon as seen of such a shape during an eclipse, but only as a velvety disc of different colours. Its motion was only about 2′ during the totality, and was rotating on its axis in the contrary direction. He, therefore, thought that such a small motion could not produce pictures so different as to give the round form which had been referred to, and which certainly could be produced by combining pictures of the moon taken at the extremes of libration. Upon the whole it was not probable that any reliable evidence that the moon was a globe, or that the streamers of the corona were solid bodies, could be obtained from pictures taken during the few minutes of an eclipse when combined in the stereoscope.

Dr. De la Rue: I do not quite understand what Mr. Ranyard means by his body of three dimensions; or what he assumes the stereoscope is not capable of bringing out.

Mr. Ranyard: I mean the bringing out of the corona behind the moon as a body having some thickness.

Dr. De la Rue: I do not know who originated the theory involved in this latter point, but I am perfectly certain that the stereoscope enables us to see that the corona lays behind the moon.

In the course of some further conversation, Dr. De la Rue said that all kinds of corroboratory evidence were required and became valuable, but he thought Col. Tennant's photographs were quite decisive as to the nature of the corona being solar.

Mr. Ranyard said that Dr. De la Rue's pictures, in 1860, proved that the corona, near the limb, was solar, but it hardly seemed possible to fix upon any distant points and submit them to measurement in the same way as the prominences. Probably the pictures required a longer exposure to obtain greater extent and detail of the corona.

Col. Tennant said some of the coronal effect might be produced by terrestrial causes, but no one who saw the last eclipse could have any doubt that the corona near the prominences belonged to the sun, and that the moon passed over it just as it did over the prominences.

Dr. De la Rue: What is the diameter of this corona?

Col. Tennant: Quite a semi-diameter of the sun.

Mr. Brett enquired whether the rifts ever came as near the limb as five minutes, and was answered that they came quite close, or within a few seconds.

Mr. Proctor: The streamers cannot produce an extension of themselves. A great part of the coronal light is doubtless reflected.

Mr. J. Beck asked whether the polarization observations did not tend to prove that the coronal matter was of two kinds. In Spain his experiments led him in this direction. The difficulty of such observations lay in the polarized light prevailing in our atmosphere during the eclipse.

Mr. Proctor: The spectroscope shows more than this. Janssen saw bright lines in the corona, and also the black lines from the reflected solar light. We must receive a considerable quantity of light from that kind of matter.

Mr. Ranyard: I think Mr. Beck's observations answer himself. There is more polarization on the corona than on the dark moon.

The discussion, which had been extremely animated, here terminated, and the meeting adjourned.

The plans of the new apartments of the Society at Burlington House, and which it is expected may be ready in about a year, were exhibited in the library, and excited much interest.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE SUPPOSED PLANET VULCAN.

Sir,—Under the heading "Cui Bono?" an anonymous correspondent (and I would remark here, *en passant*, that persons when given to adverse criticism generally find it *convenient* to adopt a *nom de plume*, instead of affixing their names to their communications,) has endeavoured to show that the record of an observation made by Mr. Waite, of the suspected Planet Vulcan, is absolutely worthless in consequence of the indefinite character of the language employed. And your correspondent, waxing humorous, thought it could appropriately be placed side by side with the remarks of the renowned Mrs. Nickleby. In your last number also, he has continued (in reply to R. E. J.) to pursue the subject, and, "by way of illustration," takes up your valuable (and limited) space with a most absurd disquisition in regard to the meetings of the R. A. S.

Now, Sir, without referring to the letter of R. E. J., (who, like many of your readers, would, no doubt, like to see Astronomical subjects more simply explained,) I should like to say to "a subscriber" in regard to the

observation by Mr. W., that I did not attach much importance to it, but simply placed it on record, believing as I do, that many facts which at one time are considered of no importance at all, may possibly acquire value at a future period, and be found of use for reference in a comparison with other observations. I know very well that Mr. W.'s statement was not altogether definite or satisfactory, and that it is scarcely possible the object he saw could have been a planet; probably it was a conspicuous sun-spot, and, if only this, I consider the observation worth recording, for it is not very often that a spot is visible to the unassisted eye, though (in consequence of the many large *maculæ* which have existed) during the last few years they have not been unfrequently observed.

"A subscriber" would have done much better if he had pointed out, briefly, the extent of the "incoherence and vagueness" of the statement in question, and not have ridiculed it in the manner he has done. It would have been much more appropriate I imagine.

Hollywood Lodge,
Cotham Park,
Bristol: May 6, 1872.

Believe me, Sir,
Your obedient servant,
WILLIAM T. DENNING.

CONNEXION OF CONJUNCTIONS WITH METEOROLOGICAL CHANGES.

Sir,—The interesting discussion of the R.A.S., reported in the current number of the *Register*, shows the wonderful advances which are being made in that branch of science which connects astronomy and meteorology. It may not be uninteresting, therefore, to give the following very curious table, which would seem to show some remote connexion between planetary conjunctions and the disturbances in the atmosphere, as denoted by the barometric range:—

	Month.	Number of conjunctions or oppositions.	Range of Barometer.
1872.	January	4	1·80 inches.
	April	2	1·37 "
	March	1	1·01 "
	February	... ...	0·66 "

These remarkable results are rendered additionally suggestive by the phenomena which have accompanied the conjunctions. In January, for instance, there were conjunctions of Mercury on the 1st, and Saturn on the 3rd; two days after, the barometer plunged down to 28·84 inches. On the 15th and 19th, Jupiter and Uranus were in opposition, and four days after the barometer descended to the amazing depth of 28·35 inches! Thus each pair of conjunctions and oppositions was followed a day or so after by a remarkable barometric depression. Of course this may be merely coincidence, but it is very remarkable, nevertheless. The conjunction of Mercury on the 10th of March was accompanied by auroræ on the 8th, 9th, and 10th, and the next conjunction of the same planet, on April 24th, by heavy thunderstorms all over the country, from 23rd to 27th. On this latter occasion, namely, the 24th, Vesuvius burst into action. On the former occasion, March 10th, temperature fell 15°, and the barometer rose 0·83 inches, both within three days. I do not offer these facts as being of much importance, but they may prove interesting to many readers.

Yours respectfully,
OBSERVER.

London: May 10, 1872.

CUI BONO?

Sir,—A "Subscriber's" reply to my letter of last March would, perhaps, be more properly answered by Mr. Waite than myself, but having once defended this gentleman's diction, I am induced to beg the insertion of these few lines, not with the view of continuing a controversy which can have little interest for your readers, but to show that the effete argument and puerile sentiments of your correspondent are far more below the standard of matter that one would look for in your publication, than the simple and honest statement of Mr. Waite which gave rise to this question. If a "Subscriber" took no particular exception to the "ordinary sized marble" form of expression, he implied it in his general condemnation of what he was pleased to call "the platitudes of the self-styled Observing Astronomical Society," and the idea conveyed to his mind that the marble might be the size of a bit of chalk, merely shows a lack of common apprehension on his part, inasmuch as I maintain that a spot on the sun described as being as large as an ordinary sized marble, does give an appreciable comparison of the two objects.

With reference to my mathematical acquirements, I know that two and two make what we are pleased to call four, and that ten twos make twenty; but I do not know what a long column of twos would be equivalent to without adding them together; and reasoning in this manner (not that my confidence in the law of gravitation is "shaky"), I venture to repeat that I have more confidence in the record of a fact happening as it were yesterday, than in the infallibility of any one calculating the position of the planets 4,000 years back.

The childish and exaggerated illustration a "Subscriber" gives of Mr. Waite's doubtful description of the time of year when the transit of the supposed planet occurred would not be worth notice, unless it were to draw attention to the care Mr. Waite took that he should not mislead. He says his house faced due West, and that the sun was setting immediately opposite, the implication to a mind of ordinary capacity being that the season must have been Spring or Autumn; but for the reason that he is unable to determine at which of these two periods the event happened, we are favoured with as lamentable an attempt at facetiousness as it is possible to imagine, probably to the amusement of a "Subscriber," but certainly not to the edification of any one who has taken the trouble to read his letter.

I am, Sir, yours obediently,

R. E. J.

London: May 6, 1872.

[We cannot insert any more letters upon this controversy.—EDITOR.]

THE UNFINISHED PROBLEM. IS THERE A LUNAR ATMOSPHERE?

Sir,—It was observed not long ago, by an American Professor, that "the hopes of Astronomy lie in the number of observers, and in the concentration of the action of many minds." Presuming, on looking at the scope and design of the *Register*, you may endorse the foregoing sentiment, I have taken the liberty, as a constant reader, to ask a place for a few remarks, on purpose to draw the attention of your *observing* readers, to an observed lunar phenomenon that I had the fortune to examine with my 11-inch silvered objective, in March last, and that

considered at the time was intimately connected with and bore upon the solution of that question at the head of this communication.

The phenomenon I refer to was the unusual appearance of the shadow, which was resting at the time of observation, on that crescent-shaped plain which has been termed by Beer and Madler the most magnificent of all lunar landscapes when fully lighted up, viz., "Sinus Iridum," a well known region to every observer. However, as I am occupied this year in registering all my lunar observations, I will insert here from my note-book the exact impressions made in the observatory during the continuance of that phase of illumination which I am about to notice.

The most remarkable appearance in the field at this hour is the shadow which covers up the level plain of Sinus Iridum. It appears not to be black like the ordinary lunar shadow, it partakes just now of a *light grey*. I see dimly through it the surface below, indicating that close to the surface some etherial matter exists, which is capable to refract and absorb some of the incident tangent beams of the rising sun.

Bearing on the point I see the Rev. Mr. Webb, in his valuable treatise on celestial objects, mentions that the late great observer, Dawes, alone has traced a faint glimmering of light in the midnight shade of some of the lunar craters, which was the result of reflection from the cliffs above illumined by the full sun, and not from an atmosphere.

In the present case, it will be observed, the conditions are different, the light grey aspect must have had its origin from some other cause, for here the shadow was sweeping over a large open plain free of all cliff brilliancy, and from *Laplace* in the west to *Heraclides* in the east, the distance is over 200 miles.

From the German measurements of the high cliff ridge which surrounds the plain we get approximately the depth or volume of the shadow across it, which, at least, cannot be less than ten or twelve thousand feet. But this phase takes place only when, in the lunation, the upper limb of the sun is just beginning to show dimly the highest peaks on the most eastern portion of the great surrounding parallelism.

Hoping that in the May lunation some with larger aperture and longer focus will inspect the above lunar phase, I will insert here some of the lunar and terrestrial conditions at the time of observation in March last.

Toronto Time.

1st. Time of observation, March 19, 6 p.m.; or, G. M. T. 19d., 11h. 17m.

2nd. Moon from conjunction, 10d. 8h.; or, G. M. T. 10d. 15h. 25m.

3rd. Moon's distance from Apogee, 10 days motion.

In conclusion, I may add, that the above notice was suggested to the writer on perusing in your March number the different reports of the last eclipse expedition to the Royal Astronomical Society.

All the different impressions made, and the various renderings given, of the same phenomenon, by our most eminent observers, are truly perplexing. It may be traced now that by a very slight geographical change of the situation of the eye within the lunar umbra at this grand spectacle. The edge of the moon affects or changes greatly the entire solar aspect, which strongly suggests among other things the importance of making every effort to solve that problem, "Is there a lunar atmosphere?"

I remain, Sir, yours respectfully,

M. TURNBULL.

Spadina Avenue, Toronto, Ontario:
April 12, 1872.

TRANSIT OF VENUS.

We are very glad to be able to announce that the United States Senate has unanimously passed a bill, appropriating 50,000 dols. to meet the expenses of the observations upon the transit of Venus in 1874, on the part of the National Observatory in Washington. The bill has been introduced into the lower house, and will doubtless soon become a law.—*Nature.*

*NOTICE OF A LECTURE BY PROFESSOR G. B. DONATI, ON "AURORÆ BOREALES, AND THEIR COSMICAL ORIGIN."**

Only the very few Italians who had travelled to regions much nearer the poles than their own country, had seen a grand aurora before October, 24, 1870.

Description of aurora of February 4, 1872 * * * * * About 8 p.m., there appeared in the south, in the constellation of Orion, luminous waves of no great size, which becoming continually brighter, mingled together; broke, disappeared, and re-appeared in forms always different; and finally arranged themselves like thin and very white darts, which formed a small but most beautiful crown, in fashion like a fan, with its concavity turned below. It seemed as if they formed an *aurora australis* on a smaller scale than the great general aurora.

Theories of Halley, Coates, and Marian. Electric theory insufficient. Electrometers do not indicate an extraordinary increase of electricity in the atmosphere during the development of auroras. Explanation of the auroral phases as a magnetic phenomena. That the aurora is an electro-magnetic phenomenon no one can now doubt—but are electricity and magnetism its cause, or merely its effect? The researches of Loomis prove that the number of auroras has a maximum and minimum about every ten years: and this is also confirmed by the examination which I have begun of a long series of records relative to auroras, in the observatory here * * * By that series it appears that in the period of about ten years, there are two or three consecutive years during which fine auroras are seen in places which are not very near to either of the poles of the earth; whilst in the intermediate years they are either not seen in those same places, or if seen are only very faint.† Since no known atmospheric phenomena can account for this decennial period, it is necessary to examine whether auroras, in place of being classed with purely meteorological, are not rather to be regarded as cosmical phenomena. This was Marian's supposition in 1733, and Olmsted's in 1856. Differing, however, from the special theory of the latter, Professor Donati proceeds to inquire whether auroras are really situated mainly in our atmosphere.

From the most accurate and recent observations, the principal phenomena of auroras happen at distances from the earth varying from 100 to 260 kilometres (from about 60 to 160 miles) and no physicist has assigned a greater height to the atmosphere than 60 kilometres (about 40 miles). It is impossible to deny that the auroral phenomena happens

* Extracted from the "Nuova Antologia," March, 1872.

† The years of the present century in which fine auroras were seen in almost all Italy, though less striking than those recently observed, were 1805, 1826-27, 1837-38-39, 1848, 1859-60, 1870-72. It is seen at once that to obtain the decennial period above indicated there is wanting only the year 1815; nevertheless, in 1814 an aurora was seen at Parma.

(for the most part at least) far beyond the limits of the atmosphere, which is also the case with not a few of the falling stars which become visible to us far beyond those same limits. But it is unquestionable that neither of these phenomena can occur in a *void.* What then exists there? Poisson imagined an electric atmosphere above our own. Quetelet supposes another atmosphere which he call *etherial*; material indeed, but with a nature and composition quite different from ours. Donati thinks this very probable; only instead of *electric* or *etherial*, he would prefer to call it *cosmical*, or, better still, *solar*, if this last would not lead to confusion, since it cannot but be a portion of that which, before the origin of our planetary system, must have surrounded, and which still surrounds our sun, from whose mass and atmosphere, according to the most generally accepted cosmogonical ideas, all the planets, including the earth, must have come forth. He next refers to the ten years (about) corresponding maximum and minimum of the solar spots, of the deviations of the magnetic needle, and of the frequency and splendour of the auroras. All the maxima, however, are not equal. In the number of the solar spots, about every sixty years there is a maximum greater than the intermediate maxima; and such a period of maxima amongst maxima appears also to have been sufficiently established with regard to the magnetic needle and the auroras. What is the correspondency or *isochronism* in these cosmical phenomena?

Kepler* supposed, and many since have also tried to prove, that the ruling force in our solar system is no other than a result or transformation of magnetism. That the forces of nature are mutually and alternately transformed in a periodical and endless cycle, and that from such transformation arises all the life of the universe, is sufficiently proved by many facts; and therefore nothing is opposed to the admission that universal attraction and magnetism may be forces of which one is a consequence of the other, and which are nearly identical. But even without such conceptions, why may not magnetism act at the same immense distances as gravitation; and who shall deny that the sun and planets are as much magnetic bodies as the earth, and in most cases even more powerful? The only difference to be kept in mind is that whilst gravitation varies with the distances of the bodies, magnetism varies according to their relative position.

If then it be admitted, as seems natural, that there is a continuous interchange of magnetic currents amongst the various bodies of our system; if, that is, there exists a *cosmical magnetism*, this may afterwards combine with the proper and peculiar magnetism of every individual body, and determine in it phenomena that are special and inherent in its particular nature. Thus, for instance, it may determine on the sun the production of spots, and many other phenomena continually observed: on the earth it may be the cause of auroras, and the variations of the needle: and in the other planets of other different phenomena, of which this is not the place to speak. But these currents at certain periods will be stronger or weaker, according to the position occupied by the planets in regard to themselves and to the sun; consequently, the derived phenomena also will be subject to consimilar periods.†

* *Astronomia Nova.*

† Donati in a note refers to his lecture on this subject in January, 1869, and says that since 1871, Professors Serpieri and Tacchini have continued their observations, which confirm the opinion he expressed in 1869. [See also a paper on *Further investigations on Planetary influence upon Solar activity*, by MM. De la Rue, Steward, and Loewy, in *Nature*, March 28, 1872].

(*To be continued.*)

REVIEWS.

Conversations on Natural Philosophy. By Mrs. Marcet.

We hail with pleasure the fourteenth edition of this useful and entertaining work, which has been revised and edited by the author's son, Francis Marcet, F.R.S. It has been made more complete by the introduction of two additional conversations on Spectrum Analysis and Solar Chemistry. The former principally derived from Mr. H. Roscoe's book upon Spectrum Analysis. It is astonishing in how clear and entertaining a light most of the leading facts of Natural Philosophy are explained in these dialogues. The whole is made plainer still by the numerous plates with which the volume is furnished.

Pamphlet of Extracts from the Thirteenth Volume of Astronomical Observations made at the Royal Observatory, Edinburgh. By C. Piazzi Smyth.

The title of this work gives a faint idea of its size and importance, it being a handsome 4to vol., of about an inch thick. It contains star catalogues from observation, a reprint of the immensely laborious account of observations of the Great Pyramid, which we noticed some time back. The form is much improved, especially as regards reference to the plates, to which there are some additions. A paper on Auroral and other faint Spectra; another on Scottish Meteorology, from 1856 to 1871; one on the Hyperborean Storm of Oct. 2nd and 3rd, 1860; and, lastly, a general description of the Royal Observatory, Edinburgh, and its occupation. There is an enormous amount of interesting matter in the volume. The paper upon faint spectra, in which some usually accepted dicta are questioned, is worthy of being well considered.

NEW NEBULÆ.

M. Borelly, of Marseilles, has communicated to the *Astronomische Nachrichten* the following catalogue of new nebulæ discovered by him at Marseilles. The positions are for 1872.

R. A. h.	m.	s.	Polar Distances. °	′	″	
6	39	21	5	26	3	Nébuleuse assez faible, étendue, de forme elliptique, pas de point brillant.
6	48	44	4	4	20	Nébuleuse assez brillant, passablement étendue, ronde; noyau de 12.13 gr. au centre.
8	51	44	11	25	18	Nébuleuse assez brillant, 3′ d'étendue, de forme elliptique, pas de noyau.
11	37	50	72	43	31	Nébuleuse ronde, peu étendue, petit noyau au centre.
11	45	26	72	28	20	Nébuleuse assez faible, étendue, de forme elliptique, pas de point brillant.
11	45	3	72	25	46	Nébuleuse excessivement faible, à peu près ronde, presqu' inobservable.

NEW VARIABLE STAR.

M. Borelly notes a new variable star in R.A. 0h. 17m. 17s., and Decl. S. 10° 10′ 10″. On November 3, 1871, its magnitude was $6\frac{1}{2}$; on November 8 it had sunk to the 8th magnitude, and on November 24 to the 10th magnitude. From November, 1871, to January, 1872, it underwent no change; and since then it has been invisible.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JUNE, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists for March and May, 1871, are available for observation in June, 1872. On p. 105 of the April number of the present volume, we have given supplement ☾ — ☉ from the 23rd, is the 31st of March, 1871, viz., 147° 34′ diminishing to 59° 4′. In Vol. IX., p. 128, the value of supplement ☾ — ☉ on May 21, 1871, was 152° 21′, and on May 31, 1871, is was 32° 8′. In the month of June, 1872, the value of supplement ☾ — ☉ on the 8th at midnight is 148° 37′ diminishing to 31° 35′ at midnight of the 18th. The two lists can therefore be combined as recommended for April and May.

It is necessary to remark that on the 26th of May, 1871, neither Piazzi Smyth nor Rumker were in sunlight. These craters may be looked for on the evening of June 13, and, if not then, in sunlight on the following evening, June 14. There is an erratum in note (*k*), for *Gandibert* read *Gaudibert.*

Sixth Zone of objects from North to South.

Atlas, Oersted, Franklin, Berzelius, Prom: Archideum (*a*), Tralles, Mare Crisium the eastern part, Picard with A and B of B and M, Snellius, Stevinus, Biela.

(*a*.) Prom. Archideum, a mountain range with a steep promontory to the North, between Geminus and Berzelius. It has a crater *a* of B and M opened on its northern summit.

This zone contains the interesting objects on the eastern part of the Mare Crisium, which have been very carefully studied by Webb. The six zones lately given will afford ample employment for the telescope, as the morning and evening terminators recede from the western limb, the objects can be well studied under the sunset illumination during the autumnal months.

On June 18, or earlier if in sunlight, the cleft from Hesiodus to Capuanus will form a fine study. Mr. Knobel has succeeded in tracing the cleft throughout its length without interruption. Observations of the cleft with large instruments are desirable.

Linne. The cone of Linné was observed as a small object on April 14. My record is as follows, "1872, April 14, 8.50 to 9.25 G.M.T., aperture 2·75 inches, power 100. I E γ^3, I E θ^1 and I E θ^2 very distinct; also the ridge I E γ^{24}, and the ridge forming the west boundary of the depression in which Linné is situated. At 8 hours this ridge was exactly on the terminator, all was dark eastward of it; at 8.50 a point of light a little eastward of it became visible. This point of light was *very small*, and apparently nearer to the west boundary of the depression than Linné is shown on my map of the Mare Serenitatis. If this point of light was the *earliest* illumination of Linné, the cone must be very small, scarcely larger than I E γ^3, which is now smaller than represented by Lohrmann and and M. Linne is certainly smaller than I E θ^2, I estimate I E γ^3 to be half the diameter of I E θ^2, and Linné two-thirds of I E θ^2. The terminator will pass over Linné on June 11, between 10 and 11 hours.

Possessors of the first sheet of my "Catalogue of Lunar objects" including area I A β, are requested to add the following, which were observed on May 15, between 8 and 10 hours, G.M.T.

I A β^{38}. An isolated mountain between Agrippa and I A β^9, shown by Schröter in T LXII, fig. 2, and by Lohrmann in both map and section I.

I A β^{39}. A peak on the S.E. border of Agrippa shown by Lohrmann only in his map and section I.

I A β^{40}. A cleft extending from I A β^{41} to I A β^{31}. It terminates at the northern part of the mountain, I A β^{31}, is a bright conspicuous object, and forks about the middle of its course. It is not shown by Lohrmann, but is well given by B. and M., on the New Edition of the large Map as *a mountain ridge,* forking as above described. Its character may be better determined under an earlier illumination than on the 15th of May. It is about double the width of the Hyginus cleft and brighter. It is found on De la Rue's photogram of Feb. 22, 1858.

I A β^{41}. A small mountain, N.E. of I A β^{6}. It is shown in fig. 2 of my notes and illustrations to the catalogue.

THE PLANETS FOR JUNE.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	1 54 55	+10 42	6″·6	22 29·1
	15th	1 59 4	+ 8 44½	5″·4	23 16·6
Venus ...	1st	3 52 48	+19 27	9″·8	23 7·9
	15th	5 5 11	+22 37	9″·8	23 22·4
Saturn ...	1st	19 28 13	—21 38	16″·2	14 44·7
	15th	19 24 51	—21 46	16″·6	13 46·3

Mercury is badly situated for observation, being too close to the sun, the greatest interval being three-quarters of an hour.

Venus is also unfavourably situated for the same reason.

Saturn may be seen almost throughout the night, but is too low to be well observed.

ASTRÆA, PALLAS, CERES.

The planet Astræa comes to opposition on the 4th of the month.

Date.	R.A.	Dec.
	h. m. s.	° ′
2nd	16 50 58	—14 35
4th	16 49 3	—14 33½

Pallas comes to opposition on the 12th.

Date.	R.A.	Dec.
	h. m. s.	° ′
2nd	17 42 18	+24 53
8th	17 37 17	+25 12
12th	17 33 52	+25 10

Ceres comes to opposition on the 26th.

Date.	R.A.	Dec.
	h. m. s.	° ′
14th	18 35 0	—26 42½
22nd	18 27 29	—27 16
26th	18 23 35	—27 31½

ASTRONOMICAL OCCURRENCES FOR JUNE, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	1		Sidereal Time at Mean Noon, 4h. 41m. 6·13s.	1st Oc. D.	9 31	β Libræ. — 10 27·3
Sun	2			2nd Tr. E. 1st Tr. E. 1st Sh. E. 2nd Sh. E.	8 40 9 6 10 2 10 30	10 23·4
Mon	3	 19 21	Sun's Meridian Passage, 2m. 6·10s. before Mean Noon Conjunction of Moon and Mercury 0° 34′ S.			10 19·5
Tues	4	15 16	Conjunction of Moon and Venus, 0° 10′ N.			10 15.6
Wed	5	15 23·4 4 46 6 11	● New Moon Conjunction of Moon and Mars, 0° 35′ N. Conjunction of Uranus and Jupiter, 0° 1′ S. Saturn's Ring: Major Axis=40″·84 Minor Axis=16″·10			10 11·6
Thur	6			4th Oc. R.	8 12	10 7·7
Fri	7					10 3·8
Sat	8					9 59·8
Sun	9	5 18 6 24	Conjunction of Moon and Uranus, 3° 19′ S. Conjunction of Moon and Jupiter, 3° 22′ S.	2nd Tr. I. 1st Tr. I. 1st Sh. I. 2nd Sh. I.	8 32 8 46 9 36 10 11	9 55·9
Mon	10			1st Ec. R.	9 9 28	9 52·0
Tues	11			3rd Sh. E.	10 5	Moon. — 4 21·2
Wed	12					5 5·9
Thur	13	19 19·2	☽ Moon's First Quarter			5 49·3
Fri	14					6 32·2
Sat	15		Illuminated portion of disc of Venus 0·989 Illuminated portion of disc of Mars 0·998			7 15·8

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sun	16	17 49	Conjunction of Mars and Venus, 0° 41′ S.			8 1·1
Mon	17	 14 49 16 14	Sidereal time at Mean Noon, 5h. 44m. 11·05s. Near approach of μ Libræ (6) Conjunction of Mars and Mercury, 0° 21′ S.			8 49·5
Tues	18	5 38	Conjunction of Venus and Mercury, 0° 23′ N.	1st Sh. E. 2nd Ec. R.	8 19 10 14 8	9 42·2
Wed	19		Sun's Meridian Passage, 0m. 39·22s. after Mean Noon			10 40·0
Thur	20	18 57·7	○ Full Moon			11 42·7
Fri	21	10 46 11 57	Occultation of σ Sagittarii ($2\frac{1}{2}$) Reappearance of ditto			β Libræ. 9 8·7
Sat	22	0 29	Conjunction of Moon and Saturn 3° 23′ N.			9 4·7
Sun	23					9 0·8
Mon	24	9 46	Superior Conjunction of Mercury			8 56·9
Tues	25		Saturn's Ring: Major axis=41″·47 Minor axis=16″·59	2nd Oc. D. 1st Tr. E.	8 43 9 37	8 52·9
Wed	26	15 29 15 52	Occultation of 30 Piscium (5) Reappearance of ditto			8 49·0
Thur	27	9 27·4	☾ Moon's Last Quarter			8 45·1
Fri	28					8 41·1
Sat	29	15 9 15 52	Occultation of B.A.C. 755 (6) Reappearance of ditto			8 37·2
Sun	30					8 33·3
JULY. Mon	1					8 29·3

SUN.

Greenwich, Noon. 1872.		Heliographical longitude of the centre of			Heliographical latitude the sun's disc.		Angle of position of the sun's axis.
		°			°		°
June 1	...	107.15	+152 δ ξ	...	—0.35	...	344·81
2	...	120·40		...	0·23	...	345·19
3	...	133·65		...	—0·10	...	345·58
4	...	146·90		...	+0·02	...	345·97
5	...	160·15		...	0·14	...	346·37
6	...	173·40		...	0·26	...	346·77
7	...	186·66		...	0·38	...	347·17
8	...	199·91		...	0·50	...	347·58
9	...	213·16	+160 δ ξ	...	+0·62	...	348·00
10	...	226·41		...	0·74	...	348·41
11	...	239·66		...	0·86	...	348·83
12	...	252·91		...	0·98	...	349·25
13	...	266·17		...	1·10	...	349·68
14	...	279·42		...	1·22	...	350·11
15	...	292·67		...	1·37	...	350·54
16	...	305·92		...	+1·46	...	350·98
17	...	319·18		...	1·57	...	351·42
18	...	332·43		...	1·69	...	351·85
19	...	345·68	+170 δ ξ	...	1·81	...	352·30
20	...	358·94		...	1·92	...	352·74
21	...	12·19		...	2·04	...	353·19
22	...	25·44		...	2·16	...	353·64
23	...	38·69		...	+2·27	...	354·09
24	...	51·95		...	2·38	...	354·54
25	...	65·20		...	2·50	...	354·99
26	...	78·45			2·61	...	355·44
27	...	91·70		...	2·72	...	355·90
28	...	104·96		...	2·83	...	356·35
29	...	118·21	+180 δ ξ	...	2·94	...	356·81
30	...	131·46		...	+3·05	...	357·27

Assumed daily rate of rotation, 14°·2 + δ ξ.

MOON.

Libration. **Sun's Place.** Selenographic long. and lat. of the point on the moon's surface which has the *Earth's* | *Sun's* centre in the zenith.

Terminator. Selenographic longitudes of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.

Greenwich, Midnight.

1872.	Earth's long.	Earth's lat.	Sun's long.	Sun's lat.	Sunset. 60° N.	Sunset. 0°	Sunset. 60° S.
	°	°	°	°	°	°	°
June 1	+6·1	+5·1	—126·2	—0·01	—36·2	—36·2	—36·2
2	5·7	4·0	138·4	+0·01	48·4	48·4	48·4
3	5·1	2·7	150·7	0.4	60·6	60·7	60·7
4	+4·3	+1·3	—162·9	+0·06	—72·8	—72·9	—73·0

					Sunrise.		
8	−0·5	−4·1	+148·1	+0·15	+57·8	+58·1	+58·4
9	1·9	5·2	135·8	0·18	45·5	45·8	46·2
10	3·2	6·0	123·6	0·21	33·2	33·6	34·0
11	4·5	6·5	111·4	0·23	20·9	21·4	21·8
12	5·6	6·8	99·1	0·25	+8·7	+9·1	+9·6
13	6·4	6·8	86·9	0·28	−3·6	−3·1	−2·6
14	7·0	6·4	74·7	0·31	15·9	15·3	14·8
15	7·3	5·7	62·5	0·34	28·1	27·5	26·9
16	7·2	4·7	50·3	0·36	40·4	39·7	39·1
17	6·6	3·4	38·1	0·39	52·6	51·9	51·2
18	5·7	1·9	25·9	0·42	64·9	64·1	63·4
19	4·3	−0·2	13·7	0·45	−77·1	−76·3	−75·5
20	2·6	+1·6	+1·5	0·48	Sunset.		
21	−0·7	3·2	−10·7	0·51	+80·1	+79·3	+78·5
22	+1·2	4·7	22·9	0·54	68·0	67·1	66·2
23	3·0	5·8	35·1	0·57	55·9	54·9	53·9
24	4·7	6·5	47·3	0·60	43·7	42·7	41·7
25	6·0	6·8	59·5	0·62	31·6	30·5	29·4
26	6·9	6·6	71·7	0·65	19·4	18·3	17·2
27	7·3	6·1	83·9	0·67	+7·2	+6·1	+4·9
28	7·4	5·3	96·1	0·69	−5·0	−6·1	−7·3
29	7·0	4·2	108·4	0·72	17·2	18·4	19·6
30	+6·4	+2·9	−120·6	+0·74	−29·3	−30·6	−31·9

The sun's disc passes the true horizon of Linné on June 12, from 6h.4 to 7h 6 G.M.T.

Books received.—"Pamphlet of Extracts from the Thirteenth Volume of the Astronomical Observations at the Royal Observatory, Edinburgh. By C. Piazzi Smyth. Neill and Co., Edinburgh, 1872." Mrs. Marcet's "Conversations on Natural Philosophy." Longmans, Green & Co., 1872. R. A. Proctor's "Essays on Astronomy." Longmans & Co.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.
Little, W.

To June, 1872.
Elliott, R.
Lancaster, J. L.
Lancaster, W. L.

To July, 1872.
Allen, E. G.
Lewis, Rev. H. K.
Ryle, Rev. J. C.

To Aug. 1872.
Hutchings, Rev. R. S.

To Dec. 1872.
Cox, H.
Garnett, W.
Hibbert, G.
Ingram, Rev. H.
Johnson, R. C.
Key, Rev. H. C.
Potter, Rev. T. J.
Putland, C.
Turberville, H.
Vallock, Rev. B.

To Dec. 1873.
Green, S.

TO CORRESPONDENTS.

SMYTH'S CELESTIAL CYCLE.—Our Sydney Correspondent, whose exact address we have mislaid, is informed that we can procure a good copy of the above work for him on same subject.

NOTICE.—It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

APPENDIX.

REPORT OF THE OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS MADE BY THE MEMBERS.

Jupiter.—Mr. H. W. Hollis, of Newcastle, Staff., reports that on January 14, 9h, the disc of the planet appeared very sharp, and he counted 22 different bands of colour. "Those visible in the equatorial parts of a beautiful delicate pinky brown. I am certain that the belts are visible up to the very edges of the disc, but there is an apparent increase of brightness for a considerable distance round the edge of the planet, probably an effect of contrast, which obliterates the extremities of the belts unless carefully looked for. Several well marked and beautifully defined irregularities in the belts showed the rotation most clearly even in half an hour's watching, Jan. 23, 8h. 15m. Satellite I. just entered on disc of Jupiter and appears as an intensely white spot. 9h. 20m., shadow of I. on centre of disc, black and sharply circular, the satellite itself cannot be seen." Mr. T. W. Backhouse, of Sunderland, observed the transit of satellite I. on Jan. 14. At 13h. 54m. it "appeared as a faint white spot." On Feb. 3, 6h. 7m., he examined satellite III., and its shadow when in transit. The satellite itself was, at the time mentioned, nearly half across Jupiter on a darkish belt. "It is much darker than the darkest part of the planet." At 7h. 30m., it was "still very plain, but only the same shade as the darkest part of Jupiter. It was smaller than its shadow which was very black."

T. Coronæ Borealis.—Mr. T. W. Backhouse says:—"A change has taken place in this star. On its fading for the second time it became stationary in brightness about the middle of the year 1867, since which time, up to the beginning of this year, it continued the same, but with frequent slight fluctuations, which, however, ceased so far as I could judge, at the end of 1869. I have suspected fluctuations since 1869, but they were doubtful. On Jan. 14, this year, I looked at the star and found it about its usual brightness, or, perhaps, a little fainter, but certainly not fainter than it had been at times previously. I did not look at it again till March 5, when I found it much fainter than I ever saw it before, perhaps half a magnitude less than usual, and it was the same on the following day."

Nebula in the Pleiades.—Mr. H. W. Hollis has looked for this nebula with his 8-in. achromatic, but cannot find it. He says, "There is something peculiar about all the brighter stars of this group, which, for months past, have appeared to me as if surrounded with nebulous lights. Can the nebula have been distributed amongst them?"

Meteors.—The Rev. S. J. Johnson, of Crediton, witnessed the appearance of "a splendid meteor at 7h. 37m., April 6. Its course was in a straight line downwards from about 15° above the N.W. horizon, to about 5°. Colour white with a greenish tinge. Duration about 5 seconds. Seen against a dark sky, this meteor would have equalled, if not exceeded, the brightness of Venus or Jupiter. I was looking for Mercury at the time." On April 19, 11h. 10m., Mr. William F. Denning, of Bristol, saw a brilliant meteor. It passed slowly down the N.N.E. sky. It was star-like in appearance and left no train of light.

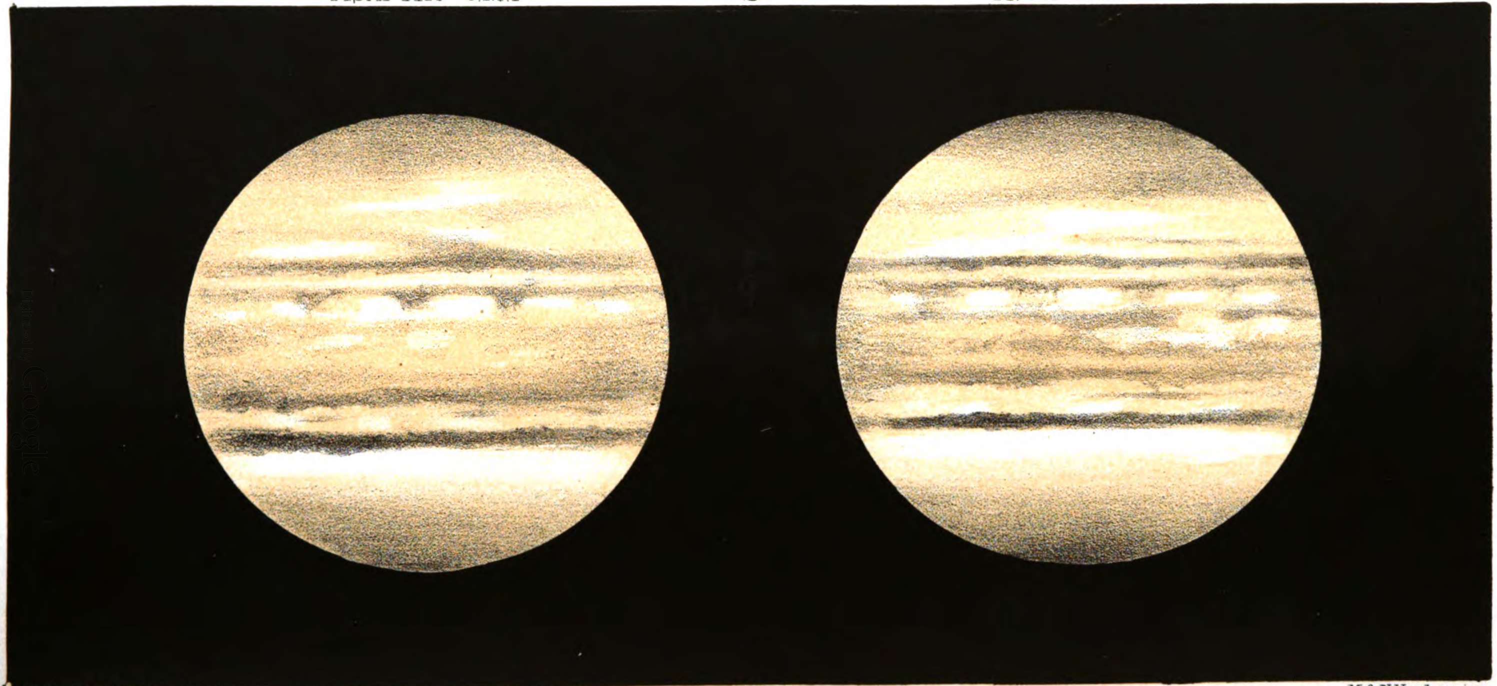
Mercury.—The Rev. S. J. Johnson observed Mercury both with the naked eye and telescope, on the evenings of March 25 and April 5. A power of 100 on a small telescope brought out the phase.

JUPITER 1872.

April 11.8 G.M.T

S

April 12_8.



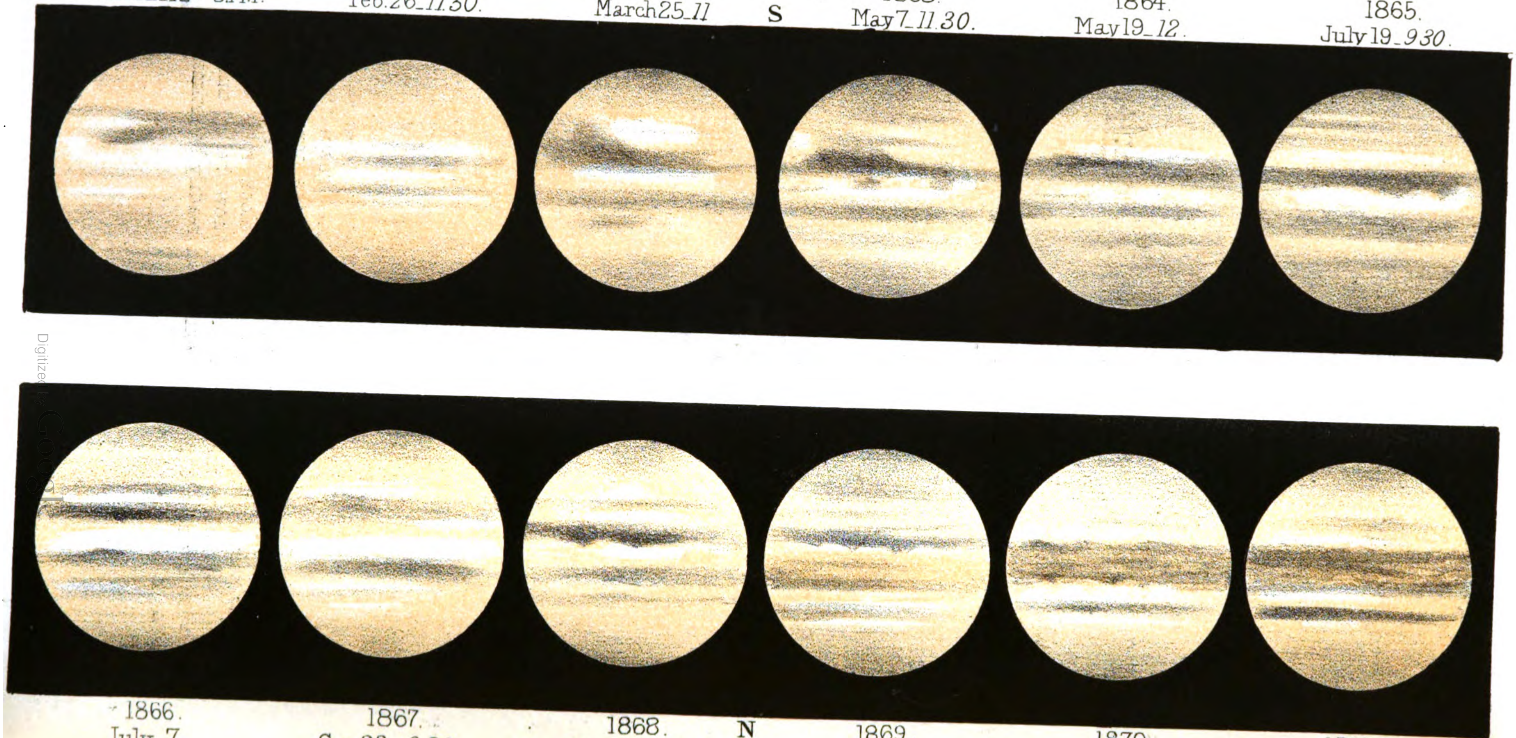
N.

N.E Green del et lith.

M & N Hanhart imp.

BELTS OF JUPITER.

From Drawings by N.E. Green, aperture of object glass. 4 in.



The Astronomical Register.

No. 115. JULY. 1872.

ROYAL OBSERVATORY, GREENWICH.

THE VISITATION.

The annual inspection of the Observatory by the official visitors took place on Saturday, June 1, when, in addition to the Members of the Board, a number of scientific men availed themselves of the invitation of the Chairman of the meeting, to make a visit to this most interesting Establishment and inspect the instruments with which so much valuable work is accomplished. The Observatory was opened at two instead of three o'clock, as on former occasions, so that ample time was secured for careful examination of the buildings and their contents. The Report of the Astronomer Royal goes minutely into detail of the work performed, and the state of the reductions and printing, and describes the present condition of the buildings and instruments. No alterations of any importance have been made in these respects, the principal addition having been that of a new normal sidereal clock, by Dent, to distribute sidereal time throughout the Observatory and make the seconds punctures on the chronograph, which, being erected in the magnetic basement, and thus kept at a uniform temperature, has rendered the clock rates almost constant; the only fluctuations observed now being due to changes in barometric pressure, which can readily be estimated

and allowed for. The objects of most interest to the visitors, both official and unofficial, appeared to be the instruments and observatories prepared for the Transit of Venus in 1874, which were to be seen dotted about the grounds. The observatories are of wood, and generally hexagonal in form. Those for the Altazimuths have revolving roofs, but for the Equatoreals portions of the roof can be removed as required. The stations, it may be remembered, are five in number, and for each a transit, an Altazimuth and a 6-inch Equatoreal have to be provided. Three first-class clocks, besides extra telescopes and clocks, will be wanted for each station. Most of these instruments are ready and were exhibited. The beautiful Altazimuths of Messrs. Simms, and the Transits by Messrs. Cooke excited universal admiration. The Equatoreals, which, as a rule, are not new, are not quite complete, but among them is the celebrated one formerly belonging to Admiral Smyth, and afterwards to Dr. Lee, and now adapted for the station at Alexandria. Many of those present recognised an old friend in this instrument to which they had been indebted for many delightful views of the heavenly bodies when at Hartwell. We were glad to find from the Report that the merits of the assistants have been acknowledged by some increase in their salaries granted by the Admiralty. The Observatory may well be proud of the devotion of these gentleman to their duties and the manner in which the work is performed, and this recognition is only what they have long deserved. The Astronomer Royal also hints that he is preparing a sketch of the history of the Observatory during his term of office which will partake of a biographical form. We need scarcely say that, looking to the vast improvements in instruments and other changes which have been introduced since 1836, this account of his labours will possess the greatest interest to all astronomers.

Perhaps the most important part of the Report is the notice in which the Astronomer Royal draws attention to the probable necessity of taking up a different class of observations in addition to those for which the Observatory is famed. He suggests that those phenomena which can be observed at convenient times, with moderate instruments, and without continuous expense, such as measures of double stars, may well be left to private observers; but that where large telescopes, constant routine and consequent expense are required, a public observatory should be employed. The scrutiny of nebulæ and planets and solar spectroscopy may *possibly* fall within this category; but he has *no doubt* that a continued series of observations of the solar spots should be carried on, and he recommends that, with this object

in view, another assistant should be added to the strength of the establishment. With these and other like investigations supplementing the magnetic and meteorological observations already constantly made, Greenwich would become *pro tanto* a *physical observatory*, and as such might, in future, produce results comparable in value with its meridional work.

These remarks, no doubt, occupied the earnest attention of the Board during their protracted sitting, and will, doubtless, bear good fruit.

The visitors and their friends dined together as usual in the evening.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Eighth Meeting, June 14th, 1872.

Professor Arthur Cayley, F.R.S., *President,* in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last meeting were read and confirmed.

Thirty-nine presents were announced and the thanks of the Society voted to the respective donors.

Rev. W. Falconer,
E. Sheppard, Esq.,
W. Mathieu Williams, Esq.,
Rev. Thos. Tordiffe,
H. W. Jackson, Esq., and
Rev. F. W. H. Courtier,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:

Discovery of Planet 121: by Professor Watson.

This small planet was discovered on May 12, in the United States.

On New Tables of Uranus: by Professor Simon Newcombe.

This was an extract of a letter to the Astronomer Royal asking for the last Greenwich observations of the planet, and stating that the author intended to conclude his labours with the use of the places obtained at the opposition of 1871-2, and hoped, after twelve years' work, very shortly to bring the matter to a close. So far as he had at present compared the results with observation, his tables gave the places within a fraction of a second of time and a second of arc, and the theory gave no indication of the existence of any trans-Neptunian planet.

Mr. Dunkin said that the Tables of Neptune now in use gave

the places with the same degree of accuracy. He also added that M. Leverrier had published an important paper in the *Comptes Rendus* on the theory of the planets Jupiter, Saturn, Uranus, and Neptune, which, at the request of the Astronomer Royal, he (Mr. D.) was translating for the *Monthly Notices*.

Occultations of Stars by the Moon, and Phenomena of Jupiter's Satellites: by the Rev. Mr. Main.

These observations were from fifty to sixty in number, and Mr. Dunkin observed that they showed the Tables of Damoiseau represented the phenomena of Jupiter's Satellites better than was usually admitted. As to eclipses of the 1st satellite the errors were almost *nil;* with the 2nd satellite, a few seconds; as to the 3rd, about a minute; and with the 4th, about three minutes. The other phenomena were not so exact; one transit egress was twenty-three minutes wrong, but the observation was a very bad one, and made under exceptional circumstances of weather, and the view being obstructed.

On the Aurora of February 4, 1872: by the Rev. Mr. Slatter.

These observations, compared with others gave, the author considered, a result showing the height of the phenomenon was 118 miles.

On the Radiant Points of Meteors: by Mr. Greg.

This was a very valuable table of the radiant points and epochs of the groups known, collated from the various observations, which agreed better than might be expected. From the researches of Schiaparelli great interest attached to the subject.

Mr. Glaisher bore testimony to the great value of this Table, with which he was well acquainted, and found it of much service where any discrepancies existed as to the radiating points of groups, by limiting the area of search.

Addition to Paper on the Errors of Vlacq's Tables of Logarithms: by Mr. J. W. L. Glaisher.

The author explained the object of this paper as being to give further corrections which had been omitted in Vega's errata.

On Photographic Irradiation in Over-exposed Plates: by Lord Lindsay.

The most cursory observer of eclipse photographs must have noticed the occurrence of a halo of light extending over the dark limb of the moon, and having a different extent where there are prominences to where there are none. This is similar to the nebulous haze or border seen in over-exposed pictures of other objects. The effect had been referred to an extension of the chemical action continuing after the light had been cut off, but, whatever the cause, the author proposed to call it *Photographic Irradiation,* and had performed an extensive series of experiments to ascertain, if possible, the circumstances under

which it was produced, and the best means of preventing it. The halo in these pictures consisted of two parts, an inner luminous border and an outer less defined fringe. The boundary between the two is difficult to fix, as they fade gradually into one another. The edge of the moon and outer limb is, of course, better defined. Lord Lindsay then detailed the apparatus and method used in order to test the production of and get rid of these appearances. A plate of blackened zinc, with a triangle cut out of it, and a wire crossing the space, was placed in front of a gas flame, and a negative taken in a portrait camera on a plain white glass with one minute's exposure. This formed an excellent standard picture. Other pictures, with the same focus, were allowed from ten to twenty minutes, and these all had extensive fringes or halos surrounding the triangle. Other plates were then tried, including white glass with one side ground, and with both sides ground. These gave results very little better. A backing of white or black paper was tried, but unless kept adherent by moisture made little difference. A backing of black asphalte varnish, giving a very dead black, was a great improvement; and non-transparent plates, such as slate and ebonite, hardly showed any halo in ten minute's exposure. The black varnish over half a plate and the other plain showed the great advantage of this mode of backing. One of the best materials was a yellow glass used for photographic dark-room windows, and called yellow *pot metal*. This, when ground on both sides and varnished, produced pictures in which it could hardly be seen whether it had been exposed for one or ten minutes. An incandescent platinum wire, heated by ten cells of Grove's Battery, was also tried as the source of light. In ten seconds the halo was hardly visible; in ten minutes very markedly produced. In order to test whether the effect was produced by chemical or optical causes, a small ivory rule was held against the collodion plate by capillary attraction, when the picture was found to be cut clean off by the limb of the rule. Apertures in black paper were printed by contact in daylight in the usual manner, but the action was found not at all to extend under the edges of the holes. The author was about to repeat this experiment with a silver plate and various apertures, and also to use dry collodion plates. He thought such plates with a dark back would do very well. These experiments seemed to show that by proper precautions the greater part of these defects in photographic pictures might be eliminated, but there would remain a very fine band of light at the limb of the moon which rendered the image different in size to that seen on the ground glass, and the extension of this halo was greatest where the light was the strongest.

Dr. De la Rue wished to bear testimony to the great value of these experiments. He gathered from them that the irradiation was caused by the reflection of light from the back of the plate. This was somewhat contrary to his expectation, but also showed that it could be pretty well eliminated. Another point was that attributing the effect to a sort of continuance of the chemical action where the light impinges he had mentioned at Greenwich, that he thought it probable the mode of producing the achromatic correction of Dallmeyer's lenses might have something to do with the effect, but he now found this could not be concerned in producing the action in question.

Mr. Ranyard said, that having seen some of the experiments, he had no doubt there was no evidence of chemical action continuing over the plate, as the rule cut off the irradiation sharply. The border was also not due to chromatic error, but seemed to be connected with the back reflection. This defect was of great importance with regard to photographing the Transit of Venus, as it would enlarge the picture of the Sun and diminish that of Venus, and there seemed no means of saying to what extent this might act. It appeared, however, that irradiation might be greatly lessened by using a reflecting telescope.

Lord Lindsay said that he had omitted to mention that with a 4-inch reflector, lent by Mr. Browning, he had obtained a much better image on the collodion of the ivory rule.

Dr. De la Rue suggested that after all the elimination possible of the irradiation, there might still be something due to continuance of chemical action.

Lord Lindsay said that after sensitizing, the collodion appeared somewhat in relief, and might act as a cylindrical lens.

Col. Tennant suggested that the apparent convexity of the image was caused in the development.

Dr. De la Rue said that with regard to the Transit of Venus observations, as the measurements would be made from centre to centre of the Sun and Planet, no error could be introduced by the irradiation.

Observations of the Planet Venus: by Mr. Langdon.

This gentleman is station master at a small country station, and having made himself a 6-inch silvered-glass reflector, had observed Venus at intervals from May 1, 1871. At first his observations were unsatisfactory and hazy, but by employing a diaphragm of blackened card with a very small hole or a slip of lightly tinted glass, he had seen a cloudy marking nearly across the Planet with pointed ends. Venus was then rather more than a half-moon in shape. He saw the same marking half an hour afterwards, and on the next evening. On May 6, he saw a club-shaped mark

and some others. These he watched with great interest, having heard the existence of such marks doubted, and called several of the railway men to look, who corroborated his observations. On May 13 and July 28, he saw some dusky marks at the terminator, and the southern horn much rounded, while the northern was quite sharp. In October both horns were sharp and some cloudy markings visible. On October 25, he had a fine daylight view, when the sunlight taking off the glare, the jagged nature of the terminator was seen, and the northern horn looked as if bent inwards to the centre of the planet. This had not been seen before or since. On November 9, he watched Venus at every half hour during the day; the terminator was jagged and looked like a piece of lace. On February 5, 1872, a few days before inferior conjunction, he saw the whole body of the planet like the moon when visible by the ashy earth light. He had strongly suspected this at other times, but on this occasion he had no doubt of the accuracy of his observations.

On Improvements in Tripod Stands: by Mr. Lecky.

Mr. Lecky exhibited a stand founded on the usual double-legged tripod used for photographic cameras, and which he stated was originally invented by Mr. John Jackson Lister, the great improver of the microscope for a camera lucida. Mr. Lecky had added certain braces and other modifications which rendered the stand very stiff and capable of being used for drawing, or to support a telescope, &c., with great advantage.

On the Orbit of Castor: by Mr. Wilson.

In a paper printed in the last *Monthly Notices*, the author had shown reason for believing that the orbit of this pair of stars might be hyperbolic. This result had been obtained by a graphical method; but he had since worked out the orbit analytically by Sir. J. Herschel's process, which he described and illustrated. The divergence of the result of this from the graphical method was great; but the latter is not to be trusted as compared with the former, on account of a very slight error vitiating the whole operation. The author referred to a chart of all the observations, and a curve drawn through them, which appeared very irregular and unsatisfactory. The interpolated curve had been corrected by the method of differences employed by Sir J. Herschel. Upon the whole the result of the analysis confirmed his former views. It is very desirable to examine the spectra of the two stars A and B composing Castor, but he has not yet had time to do this. Should the form of orbit suggested by him be confirmed, we have seen a near approach of the two stars which will never happen again.

Dr. Huggins, at the request of the President, gave an oral statement of the substance of a paper read at the Royal Society on the

previous evening, detailing his further *Spectroscopic observations* with the large telescope now in his possession. The matter of the paper was divisible into two parts. One related to a more careful comparison of the brightest line in the spectrum of the gaseous nebulæ with the nitrogen line, and the second division was an extension of the investigation of the motion of Sirius to other stars. With respect to the first subject, the observer ought to be very sure that the method of sending the light for comparison into the instrument was as perfect as possible, which the ordinary prism over part of the slit was not. He had tried a modification of this method in the shape of a small silver plate, which, with great care, was much more trustworthy. In the researches on Sirius, he had depended not only on this reflector, but had also placed his light for comparison in front of the object glass; but with a telescope 15-feet long, this was both inconvenient and troublesome. He had now, therefore, placed the vacuum tube or electrodes in the telescope itself exactly in the axis of the instrument, the tube being covered all but about the one-tenth of an inch. It would be remembered that immediately after seeing the three bright lines of the gaseous nebulæ, he had found that the brightest coincided with one of the nitrogen lines. This was a double line, and he had tried to discover whether the nebulæ line was so also, but the 8-inch telescope did not give light enough, nor was the spectroscope dispersion strong enough. He was now certain that the line of the nebula was single only, and coincided exactly with the centre of one of the nitrogen lines, both of which were nebulous in character. There were two explanations of this. It might be that the line under certain conditions of temperature and pressure became single and defined at edges. A motion of 30 or 40 miles per second would cause the line to shift from the middle of the double line to the less refrangible one. He had tried whether the nitrogen line became single when made excessively rare, but it did not. He felt pretty certain that the nitrogen line continued double, and did not shift under the conditions mentioned. It therefore stands that the nebula line may not be nitrogen at all, or may shift its place and partly fade out under certain conditions of motion, temperature, or pressure not yet ascertained. His experiments had been made on the nebula in Orion, but he meant to try others to decide the point.

The second part of his paper related to the observations on the proper motion of the stars being an extension of his method applied to Sirius to stars somewhat smaller. His former paper placed the result as to Sirius as giving the motion of that star from the earth at twenty-five miles per second, but a repetition of the

observations had reduced this to a velocity of from eighteen to twenty-two miles per second. Other stars had been examined, the results being embodied in the following Table.

The numerical results are provisional only, as the amount of shift could only be estimated.

STARS FROM SUN.

	Compared with.	Apparent motion.	Earth's Motion.	Motion from sun.
Sirius ...	H	26 to 36	—10 to 14	= 18 to 22
Betelgeuse ...	Na	37	—15	= 22
Rigel ...	H	30	—15	= 15
Castor ...	H	40 to 45	—17	= 23 to 28
Regulus ...	H	30 to 35	—18	= 12 to 17
β Leonis ...	H			
δ Leonis ...	H			
β, γ, δ, ε, ϑ Urs. Maj...	H	30	—9 to 13	17 to 21
η Urs. Maj. ...	H			
α Virginis ...	H			
α Cor. Bor. ...	H			
Procyon ...	H			
Capella ...	H			
Aldebaran ...	Mg			

STARS TOWARDS SUN.

	Compared with.	Apparent motion.	Earth's motion.	Motion towards sun.
Arcturus ...	Mg	50	+5	55
α Lyræ ...	H	40 to 50	+3·9	44 to 54
α Cygni ...	H	30	+9	39
Pollux .	Mg	32	+17	49
α Urs. Maj. ...	Mg	35 to 50	+11 8	46 to 61
γ Leonis				
ε Bootis				
γ Cygni				
α Pegasi				
γ Pegasi				
α Androm.				

Speaking generally, those stars opposite Hercules were receding from, and those near that constellation were approaching to, the sun, but there were exceptions. It was almost certain that the motion was compounded of three parts: 1st, an apparent motion, due to Sun's motion towards Hercules; 2nd, a probable motion of great groups of stars; and 3rd, a probable motion of separate stars. Mr. Proctor had obtained from his graphical exhibition of the proper motions of stars strong evidence in favour of their motion in groups. There was a remarkable instance in the Great Bear, where five of the seven principal stars had similar

proper motions, and α and η had proper motions in opposite directions. The spectroscope showed all fire receding, and α to be approaching. The spectra of the five stars were similar, while that of α was different. Castor and Pollux had different proper motions, and their spectra showed that one was approaching and the other receding. In Leo α and β had proper motions agreeing, and their spectra showed they were moving from the earth, but with γ Leonis both proper motion and direction were the reverse.

Mr. Proctor said that he remembered when his Paper on Star Drift was read to the Royal Society, and he had referred to spectrum analysis as likely to support his views, the Chairman (the late Dr. Miller) expressed doubts whether this could ever be used except in the case of a few very bright stars, and he (Mr. P.) had said that if it were done Dr. Huggins was the person to do it. He (Mr. P.) now felt prouder of having prophesied this than of the paper which had called attention to the effect of the proper motions.

On the Tides in Mars: by Mr. De Crespigny.

Mr. Proctor said that the author in advocating the existence of tides in Mars without a moon had omitted several considerations, and he did not think we had any evidence in support of the hypothesis of such tides.

Observations of the Spectrum of the Zodiacal Light at Palermo: by Professor Piazzi Smyth.

Angstrom found in this spectrum the same bright line seen in the terrestrial aurora, and Lias, in Brazil, saw also a strong continuous spectrum. Webb, in England, arrived at the same result; and Respighi, during his return from the eclipse, saw also the auroral line in the Zodiacal light, but a few days later saw it equally distinct all over the heavens. It might, however, have been connected with an aurora. Professor Smyth describes the instrument he used, and with it, at Palermo, saw the line in the aurora. With the same spectroscope and slit he looked at the Zodiacal light, but could see nothing whatever. With a wider slit he saw a continuous spectrum. This seems to show that the observers have been deceived, and instead of the Zodiacal light they have observed a faint aurora. The author compared the Zodiacal light and faint twilight, which agreed exactly. He also observed the phosphorescence of the sea, which gave a continuous spectrum, but the maximum was not the same as in that of the Zodiacal light and twilight. The general starlight gave the same result.

Mr. Proctor thought the observations rather doubtful, from Professor Smyth having used so many as nine prisms. With three or five he would have had a better chance upon such objects.

On the Desirability of Watching for the November Meteors in the Present Year: by Mr. Proctor.

It having been recorded that no meteors were seen in several hours last year, Mr. Glaisher had stated that it would be unnecessary to watch again, but the author found that in Italy and at Alexandria a good many were noticed producing some approach to a display. Schiaparelli had also noticed that in 1818 there was a fine shower. This was when the cluster would be about half way round its orbit. Mr. Proctor, therefore, counselled keeping watch for several nights at the usual period for seeing the Leonides.

On the rich Nebular Regions in Virgo and Coma Berenicis: by Mr. Proctor.

This paper referred to a chart of all the stars in this part of the heavens, from Argelander and all the nebulæ from Sir J. Herschel's catalogue. The author noticed that where the clusters seemed breaking up, nebulæ were also abundant; but where this appearance was absent, there were also no nebulæ.

Mr. Browning exhibited a small model of a lunar crater, made by General Worcester, designed to show the capability of a new material, composed of prepared chalk, milk of sulphur, and gum water, which could be worked upon in a plastic state for some time, and then set very much harder than plaster of Paris, and could even be altered by moistening with gum water again.

On certain Phenomena seen surrounding the Limb of the Sun in Telescopes: by Mr. Brett.

In solar eclipses a halo is seen round the moon, but the observations have hitherto been limited to total eclipses. The author has observed certain appearances which seem to indicate that we may perhaps see the corona every day. Of course what he noticed was not on a black ground, but a sort of halo of a steel-grey with a tint of green in it. The aperture of the telescope is not of much consequence, but the dark glass employed must be of the lightest tint that can be used. Sometimes even the appearance of such rifts as were noticed in the eclipse of 1870 had been seen, and he had shown the phenomena to several persons. He had tried all means to get rid of them in vain, and finding his observations corroborated, thought they should not be suppressed.

Mr. Browning had tried the experiment, and in many instances he had succeeded. In using a silver film to deaden the light, a huge halo was produced, and at first he thought this was the sole cause of the colour, but he found it equally present with different kinds of neutral tint glasses. With a 12½-inch reflector or a 2-in. achromatic, he always got a luminous edge round the sun's disc.

This morning he had noticed an appearance of which he made a sketch on the blackboard. He did not say it was a solar corona, but it did not arise from the eye-piece or the coloured screens. Dr. Huggins had suggested it might be due to the eye of the observer.

Dr. Huggins mentioned that a friend of his had looked for these appearances in vain.

Capt. Noble said that some years ago* he observed the dark limb of the moon projected on the sky during a partial eclipse, and, upon stating it to the society, was asked by the Chairman (Professor Pritchard) whether he was using a coloured glass, and upon his replying yes, was told that "accounted for anything," but perhaps after all his observation was not so worthless as had been supposed.

Mr. Chambers said he had seen the phenomena in question.

Lord Lindsay did not think it could be the corona that was seen, as a dark glass was used, and the corona as seen in eclipses could not possibly be seen through a dark glass.

Colonel Tennant agreed in this, and said he had looked for the projection of the moon's limb on the sky at the last eclipse, and was certain that it was not visible. It may have been seen sometimes, but was not then.

On future Solar Eclipses: by Rev. J. S. Johnson.

On Eclipse Photography: by Mr. Brothers.

Comparison of the Photographic Pictures of the Corona taken in 1869-70-71: by Mr. Ranyard.

Observations of Jupiter in 1871-72: by Mr. Browning.

This paper was illustrated by four beautiful coloured drawings of the planet, and the author explained that his attention had been concentrated on obtaining the most striking examples of the colouring of Jupiter, and that the details of configuration had therefore, received less attention, the nights chosen being those when coloration was strongest.

It was announced that two of the drawings would be reproduced in chromo-lithograph for the *Monthly Notices.*

The meeting then adjourned till November.

Errata in last report.

The occultations observed by Capt. Noble (p. 134) took place on April 18th, 1872. In line five for 10h. read 11h. Page 140, line 31, for *formal* read *journal.*

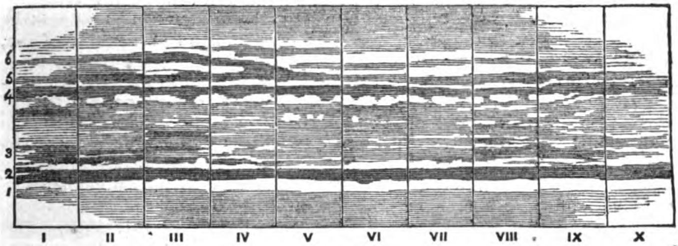
* March 6, 1867, *Astronomical Register*, Vol. V., p. 83.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

PLANISPHERE OF JUPITER, APRIL, 1872.



Sir,—The planet Jupiter is passing from our view, and exact observations of its belts must be deferred until it has passed its superior conjunction. Considerable changes, both in the disposition and colour of the belts, have occurred during the last three years. These changes have attracted much attention, and formed the subject of several interesting letters in the *Register*. Having observed the planet somewhat closely through the past twelve years, during which time it has been my habit to obtain a drawing on every available occasion, I trust that a rough sketch of the general arrangement of the belts, as exhibited in these studies, may be acceptable to some of your readers. Observations were commenced in the spring of 1859; at that time the planet was passing from opposition, and whether from great faintness in the markings of the belts, or inexperience in the observer, no lines on its surface could be perceived. In the fall of that year several studies were made in the early morning, when the belts were clearly visible, showing a great development of the southern dark belt, the northern being comparatively weak; the centre of the disc was then occupied by a band of light. From 1860 to 1863 there was a general tendency in the southern dark belt to increase in size and activity; while the northern, though it generally increased after opposition, continued the smaller, and was less given to change. The central band of light exhibited frequent spots, and was also somewhat reduced in breadth. From this period to 1867 the southern belt gradually lost its size and tendency to alteration in form, whereas the northern became more evident and active. In September of this year the northern belt was very dark, and brownish in colour, while the southern, though broader, was faint and gray; the centre of the planet being occupied by a brilliant white band. In 1868 the southern dark belt resumed its activity, exhibiting frequent spots of a darker tone, and the centre of the planet retained its white appearance. But between the end of this year and the opposition of 1869 great changes had taken place; the central light had disappeared, its place being occupied by a broad band of a yellowish copper colour, and the whitish portion of the disc was then, for the first time during these observations, on the north side of the northern dark belt. In October of 1869, colour took a very prominent part in the appearance of the disc, the southern belt being

gray, while the northern was decidedly blue, and the whole surface of the planet seemed streaky from the number of small belts, which extended nearly to the poles. From this important period to the present time the general appearance has not greatly changed; the intensity of the copper colour has somewhat disappeared, and there has been considerable activity in the smaller belts and markings, especially towards the south; also a decided tendency to permanence and increase in the dark northern streak, No. 2. A glance at the lithograph will present these changes more readily to the eye than a page of description: there the tendency of the southern dark belt to maintain its preponderance till 1868 will be clearly seen, as also the strength of the central band of light in 1866-7, and its change to the copper tone in 1869.

An endeavour is made in the two larger drawings of the plate to represent the general features of the planet in April last, and as the second of these views was procured on the following evening, and at about the same hour, the two drawings present very nearly opposite portions of the planet's surface. It must not be understood that these drawings exhibit all that could be seen, but all that could be fairly drawn. In moments of steadiness of the atmosphere a minute mottling of the surface was perceptible, and the belts appeared fringed with smaller markings. But these glimpses were most tantalising, being utterly beyond the power of the eye to seize, or of the hand to follow. Few indeed have been the evenings since February last, when a choice 9-inch With-Browning Reflector was mounted, that a higher power than 200 could be used with advantage. However, during the last three months over forty drawings have been secured, and a short account of the method of arranging them for comparison may not be out of place.

When a definite mark has reappeared on several occasions, the drawing in which it is most central is chosen as a starting point, and the disc divided by a simple perspective diagram into five equal parts, the central division being called the first hour. A calculation is then made for each drawing, allowing 595 minutes to a revolution, and the time of each registered underneath the drawing. By this means the equator of the planet is divided into ten portions, each division answering fairly to an hour of revolution; thus one drawing can be readily compared with another, and changes become more evident, being presented to the mind in this simple but effective manner. When a sufficient number of drawings has been made, they are combined in the form of a planisphere, an example of which is given in the woodcut at the head of this letter, in which the fourth and eighth hours form the centres of the two drawings. This method of study has been found very interesting and instructive, as it exhibits, in the most conclusive manner, the bearing of the markings in one drawing with those of another, and occasionally develops the most unexpected connections. The whole surface is also presented at one view, and thus the peculiar features of any portion are made more impressive. The numbers at the side of the woodcut are adopted from Mr. Jos. Gledhill's arrangement, and are most convenient when referring to any particular belt. Hoping that your readers will not be offended at the length of this letter, but that it will be received as a humble effort to promote a systematic study of this King of the planetary world.

I remain,

Yours respectfully,

NATHL. G. GREEN.

3, Circus Road, St. John's Wood,
London: May 20, 1872.

ASTRO-METEOROLOGY.

Sir,—"Observer" is only treating us again to a few platitudes on the subject of the weather.

Of what conceivable scientific value, I would ask, can we consider a system, or theory, to be which connects the opposition of a planet with a barometric depression occurring 4 days afterwards? Why, if we are to admit this, and say that the effect of such opposition may be visible 4 days before, or after it occurs, this gives us 9 days altogether, or about a third of a month, during which we may look for a coincidence of some sort. Besides, before rushing into print, has "Observer" examined his former meteorological registers? because I fancy that I have somewhere heard or read that both Jupiter and Uranus have been in "opposition" before last January.

Nothing is more fallacious than a deduction drawn from insufficient data. To render "Observer's" hypothesis worth a rush, a long sequence of planetary "aspects" should be compared (*fairly*, not in 9 day periods) with the recorded barometric pressure at Greenwich. A few extremely doubtful coincidences prove nothing. Did your correspondent never hear of the appearance of the Goodwin Sands in the North Sea, contemporaneously with the building of Tenterden Steeple?

I am, Sir, obediently yours,

June 7, 1872. ANOTHER OBSERVER.

CONNECTION OF METEOROLOGY AND ASTRONOMY.

Dear Sir,—I have read with great interest, in your report of the Meeting of the Royal Astronomical Society, April 12, 1872, Col. Strange's paper; and the discussion which followed cannot but draw attention to the fact that Meteorology and Astronomy are closely connected, and that by the joint study of those sciences we may arrive at the practical results alluded to by the Astronomer Royal.

Since the publication of the "Edinburgh Temperature Record," by C. Piazzi Smyth, Astronomer Royal for Scotland; and the results arrived at, at the Cape of Good Hope, by Mr. Stone; together with the coincidence between the condition of the sun's surface and Toronto Rainfall, which has been clearly established; it seems to me impossible to avoid the conclusion that there is some *direct* or *indirect* connection between the sun spots and weather changes.

It may be of importance that additional observatories should be brought into existence to prosecute this work (and I regret the discontinuance of the Kew observations: three or four sun spot periods are needed to settle some important questions), but it is possible that materials exist already, which, if properly used, may help to show still further that important *practical* results may follow the establishment of such an observatory as Col. Strange contemplates.

But though such a work may not be carried into effect, something may be gained if your readers will send to the *Register* the annual means of any observations to which they have access.

For instance: the Table which you published in the *Register* of Nov., 1871, in the letter of W. Lawton, Esq., of Hull, teaches a lesson which, perhaps, he has not noticed himself.

Let the numbers of clear nights given in that table be thrown into a curve, and it will be seen that our Yorkshire friends have had a very

cloudy period at the maxima and minima of sun spots; and fine, clear weather between maximum and minimum. That table does not give the number of cloudy nights for 1871, the year of sun spot max. (or possibly the one immediately following). I doubt not, if he will now supplement that table, we shall find 1871 a cloudy year.

I will, with your permission, call attention to a few additional facts in this and a following letter, and hope your readers will furnish others.

Since the year 1854 a record has been kept by the Toronto Harbour Master of the height of the water in Lake Ontario, and as this lake is fed by rivers extending over a large territory, it gives an excellent method of estimating the general precipitation during that period.

The figures show in inches of annual mean height above a zero, which is an arbitrary mark, on a scale used for the purpose of measuring the water height.

TABLE IV.—ANNUAL MEAN HEIGHT OF WATER ON LAKE ONTARIO.

Year.	M. Height.	Year.	M. Height.	Year.	M. Height.
1854......	23.1	1860	18.3	1866	9.3
1855......	17.8	1861	27.4	1867	19.7
1856......	20.6	1862	26.6	1868	4.6
1857......	27.5	1863	20.4	1869	16.0
1858......	31.4	1864	18.0	1870	30.0
1859......	28.6	1865	15.0	1871	2.0(?)

By making a curve of these numbers we find that the state of our Lake's waters has been low about the time of sun-spot maxima and minima.

Truly yours,

A. ELVINS.

MERCURY.

Dear Sir,—By the appendix to the *Register* for the present month, I see the Rev. S. J. Johnson observed the planet Mercury on the evenings of the 25th March and 5th April.

Having a good aspect westward, my residence being situated on the extreme western limits of the town, I carefully searched for the planet on every opportunity during its last eastern elongation, but only on the evening of the 26th March, at 7·30, was I able to obtain a brief glimpse of this rarely seen member of our system, and this only through vapours which seriously interfered with the definition of an excellent 2-inch refractor by Thos. Cooke and Sons, equatorially mounted.

By far the most satisfactory view I ever had of this planet was about 6·15 on the evening of the 15th February, 1868, one of the clearest I ever remember. On that occasion, with powers from 50 up to 100 on the above instrument, I was able to observe the gibbous aspect of the planet, and also took note of its brilliancy. Part of the entry in my notebook is as follows: "With a power of about 50 the gibbous aspect of the planet is visible, and its disc very bright." On the following and succeeding evenings I was again on the look-out; but only on the 16th, from 6 to 6·15, was I able to get even a transitory sight through openings in

passing clouds. I had, however, the additional satisfaction of seeing Mercury and Jupiter (the smallest and the largest members of the solar system), both just within the limits of the same field. I felt much disappointed that the very unfavourable weather of the present Spring allowed no good opportunity for turning a 7 feet silver-on-glass Newtonian upon it. Is it that the possessors of the numerous large and excellent Refractors (both public and private) are equally unfortunate as regards the weather that we hear so little of this planet? So far as I am aware the equatorial band-broken terminator or truncated horn, delineated by Schröter, observing with a Reflector, have not, as yet, been confirmed by English observers. The late Admiral Smyth, in the first volume of his "Celestial Cycle," page 97, writing of Mercury, states: "I have watched him in the telescope through all his various aspects from the full gibbous to the thin crescent, but he was always far too dazzling for the detection of any penumbræ or luculi of the supposed dense atmosphere; therefore, of the truncated horn of his cresent or the mountains, or their probable height and effect in modifying the intensity of heat, can offer nothing from personal observation. My large instrument was not the best adapted for the work; since, though achromatics are most convenient from their reduced focal length, they are decidedly disadvantageous in those cases where it is necessary to command distinctness of vision under low magnifying powers.

Permit me, in conclusion, to suggest the observation of Mercury, whenever and wherever practicable, to some of the owners of silver-on-glass Reflectors larger than my own (7-in. by 7-ft.)

I remain, dear Sir, yours truly,

WILLIAM LAWTON.

5, Victoria Terrace,
Victoria Street, Derringham,
Hull: 14th June, 1872.

QUERIES.

Can any of your readers give me answers to one or both of the following questions?

1. What was the total eclipse in England next preceding that of 1715? Was there nothing between that and the Black Saturday of 1433?
2. Is a 3-inch achromatic sufficient to show indications of the markings on Mars about the time of an opposition?

A SUBSCRIBER.

THE NEBULA IN THE PLEIADES.

Sir,—Reading in the June *Register* a statement that this object has been unsuccessfully searched for with an 8-inch achromatic, and a query as to whether the nebula has dispersed itself among the stars of this cluster, I think it should be known that since December, 1869, this object has always been seen without any difficulty in the 12¼ speculum, and that during the first three months of the present year, the Pleiades have received more than usual attention, as I have been laying down a rough chart of the relative position of its components, and of the nebula. Among them is a large, oval, ill-defined object, with the star Merope a little within the northern and smaller end, the faint haze extending sufficiently far north of this star to include a pair of very faint stars, making a neat double with a low power; from Merope it extends a long way

south, a little preceding, and it can certainly be traced from the pair of stars just mentioned a distance of 25 minutes southwards.

The preceding remarks refer to its appearance as seen in a comet eye-piece of large field and low power, not more than about 45 : with higher powers it is seen with difficulty, and, in fact, might be easily missed altogether, and this is especially the case with an equatorial telescope accurately driven by clockwork ; for, as I have often found after viewing the nebula with the comet eye-piece, on applying an achromatic eye-piece of about 150, it was invisible. Notwithstanding, I knew it was central in the field, and it was only after stopping the clock, or moving the telescope, that it could be perceived, and even then with great difficulty. Here, then, we have a very probable explanation of many of the supposed changes which this nebula has been supposed to undergo, although observed with large and well-mounted instruments ; and it appears more than ever certain to my mind, bearing in view the extreme tenuity and extent of this object, that we see it now exactly as it has existed for many hundreds and, perhaps, thousands of years.

I am, yours truly,

Richmond : June 10, 1872. CHARLES GROVER.

SUN.

Greenwich, Noon. 1872.	Heliographical western longitude of the centre of the sun's disc.		Heliographical latitude	Angle of position of the sun's axis.
	°		°	°
July 1	144·71	+180 δ ξ	+3·16	357·73
2	157·96		3·27	358·18
3	171·21		3·38	358·64
4	184·46		3·48	359·10
5	197·71		3·59	359·56
6	210·96		3·69	0·02
—				
7	224·21		+3·80	0·47
8	237·46		3·90	0·93
9	250·71	+190 δ ξ	4·00	1·38
10	263·96		4·10	1·84
11	277·21		4·20	2·29
12	290·46		4·30	2·74
13	303·71		4·39	3·19
—				
14	316·96		+4·49	3·64
15	330·20		4·58	4·08
16	343·45		4·67	4·53
17	356·70		4·76	4·97
18	9·95		4·86	5·41
19	23·19	+200 δ ξ	4·94	5·85
20	36·44		5·03	6·29
—				
21	49·68		+5·12	6·72
22	62·93		5·20	7·15
23	76·17		5·28	7·58
24	89·42		5·37	8·01
25	102·66		5·45	8·43

26	... 115·91	...	5·53	... 8·85
27	... 129·15	...	5·61	... 9·26
28	... 142·39	...	+5·68	... 9·68
29	... 153 63 +210 $\delta\ \xi$	...	5·76	... 10·09
30	... 168·87	...	5·83	... 10·50
31	... 182·11	...	5·90	... 10·90

Assumed daily rate of rotation, 14°·2 + $\delta\ \xi$.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JULY, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists for April and June, 1871, are available for observation in July, 1872. On p. 127 of the May number of the present volume, the value of supplement of ☾ — ☉ from the 21st to the 30th of April is quoted as 155° 38,′ diminishing to 53° 45.′ On July 7 the value of supplement ☾ — ☉ is 155° 43.′ In vol. IX., p. 149, the values are for June 20 and 30 respectively 148″ 10 3′ and 22° 7·5.′ On July 18, 1872, supplement ☾ — ☉ = 22° 29·0.′ The two lists, April and June, may therefore be combined for the purpose of indicating those objects that may be observed between July 7 and 18, inclusive.

Seventh Zone of objects from North to South.

Cepheus, Macrobius, Proclus, Taruntius, Messier, Goclenius, Cook, Reichenbach, Rheita, Steinheil, Hagecius.

The objects given in this and the preceding six zones are found on the western quarter of the Moon's visible hemisphere, the eastern boundary of which is 25° of west longitude. They are so situated as to be seen under oblique visual angles, and may be employed as admirable studies of variation of *form*, resulting from alternate recess and approach from and to the eye, the effects of libration in longitude. When the Moon is in Perigee or Apogee these objects are in their normal positions, as seen from the earth, so far as their distances in longitude from the centre of the disk is concerned. When the Moon is passing from Perigee to Apogee they are east of their normal positions, and are more favourably placed for observation than when the Moon is passing from Apogee to Perigee, during which time they are seen more westwardly nearer the limb and further from the eye. This is the case between the 7th and 18th of July, the Moon passing from Apogee to Perigee. Careful records of such studies as above alluded to are very desirable; and the more so as it is highly probable that the floors of large formations—Petavius, for example—may vary in tint, light or dark, independently either of illuminating or visual angles. Any variations of tint dependent upon the surface being viewed more or less obliquely, under increasing or decreasing oblique light, must have regular periods of increase and decrease of intensity; and it is of the utmost importance that these periods should be well determined, as well as the regular progression of the tint curve of the floor dependent upon the Sun's altitude above the horizon of the formation, in order that a clear line of demarcation may be drawn between, *first*, absolute variation of tint dependent upon solar influence; *second*, relative variation of tint dependent upon oblique vision; *third*, absolute variation of tint dependent upon lunar forces in active operation.

ASTRONOMICAL OCCURRENCES FOR JULY, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Mon	1		Sidereal Time at Mean Noon, 6h. 39m. 22·87s.	4th Tr. I.	9 3	α Lyræ. 11 51·3
Tues	2		Sun's Meridian Passage, 3m. 46·03s. after Mean Noon	1st Tr. I.	9 18	10 47·4
Wed	3			1st Ec. R.	9 23 20	11 43·4
Thur	4	2 34 23 30	Conjunction of Moon and Mars, 0° 58′ S. Conjunction of Moon and Venus, 1° 58′ S.			11 39·5
Fri	5	6 24	● New Moon			11 35·6
Sat	6	11 20 14 35 23 49	Conjunction of Moon and Mercury 1° 55′ S. Conjunction of Moon and Uranus, 3° 22′ S. Conjunction of Moon and Jupiter, 3° 39′ S.			11 31·6
Sun	7	8 34	Conjunction of Uranus and Mercury, 1° 19′ N.			11 27·7
Mon	8					11 23·8
Tues	9	11 13 9 37	Opposition of Saturn Near approach of *i* Leonis (6)			11 19·8
Wed	10	6 42	Conjunction of Jupiter and Mercury, 1° 12′ N.			11 15·9
Thur	11					11 12·0
Fri	12					Moon. 5 11·3
Sat	13	7 48	☽ Moon's First Quarter			5 54·5
Sun	14	9 32	Near approach of 2 Libræ (6)			6 40·1
Mon	15	17 47	Superior Conjunction of Venus Saturn's Ring: Major Axis=41″·60 Minor Axis=16″·92 Illuminated portion of disc of Venus 1·000 Illuminated portion of disc of Mars 0·992			7 29·1

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Tues	16	9 42 10 54	Occultation of B.A.C. 5395 (6) Reappearance of ditto			Moon, 8 22·8
Wed	17	11 28 13 5	Near approach of 39 Ophiuchi (6) Occultation of θ Ophiuchi (3½)			9 21·9
Thur	18		Sidereal time at Mean Noon, 7h. 46m. 24·35s. Sun's Meridian Passage, 5m. 56·58s. after Mean Noon			10 25·5
Fri	19	8 13	Conjunction of Moon and Saturn 3° 12′ N.			11 31·7
Sat	20	1 53 16 6	○ Full Moon Occultation of B.A.C. 7197			α Lyræ. — 10 36·6
Sun	21	18 3 11 38 12 37	Conjunction of Uranus and Venus 0° 31′ N. Occultation of B.A.C. 7550 (6) Reappearance of ditto			10 32·6
Mon	22	14 27 15 37 15 56 16 47	Occultation of τ^1 Aquarii (6) Reappearance of ditto Occultation of τ^2 Aquarii (4) Reappearance of ditto			10 28·7
Tues	23	17 41	Conjunction of Sun and Uranus			10 24·8
Wed	24	2 43	Conjunction of Mercury and α Leonis (3·3m. E.)			10 20·8
Thur	25					10 16·9
Fri	26	19 18 13 46 14 46	☾ Moon's Last Quarter Near approach of 64 Ceti (6) Near approach of ξ^1 Ceti (4½)			10 13·0
Sat	27					10 9·0
Sun	28	14 22	Conjunction of Jupiter and Venus 0° 40′ N.			10 5·1
Mon	29					10 1·2
Tues	30	16 14	Near approach of 121 Tauri (6)			9 57·2
Wed	31					9 53·3
AUG. Thur	1	22 36	Conjunction of Moon and Mars 2° 17′ S.			9 49·4

MOON.

	Libration.		**Sun's Place.**		**Terminator.**		
	Selenographic long. and lat. of the point on the moon's surface which has the *Earth's* centre in the zenith.		Selenographic long. and lat. of the point on the moon's surface which has the *Sun's* centre in the zenith.		Selenographical longitude of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.		
Greenwich, Midnight.					Sunset.		
	long.	lat.	long.	lat.	60° N.	0°	60° S.
1872.	°	°	°	°	°	°	°
					Sunrise.		
July 9	—4·5	—6 7	+129·2	+0·92	+37·5	+39·2	+40·8
10	5·6	6·7	116·9	0·94	25·3	26·9	28·6
11	6·5	6·4	104·7	0·96	13·0	14·7	16·4
12	7·1	5·8	92·5	0·98	+0·7	+2·5	+4·2
13	7·5	5·0	80·2	1·00	—11·5	—9·8	—8·0
14	—7·4	—3·8	+68·0	1·03	—23·8	—22·0	—20·2
15	7·0	2·4	55·8	1·05	36·0	34·2	32·4
16	6·1	—0·8	43·6	1 07	48·3	46·4	44·5
17	4·9	+0·9	31·4	1·09	60·5	58 6	56·7
18	3·3	2·6	19·2	1·12	72·7	70·8	68·9
19	—1·3	4·1	+7·0	1·14	—84·9	—83·0	—81·0
20	+0·7	5·3	—5·2	1·16	Sunset.		
21	+2·9	+6·2	—17·4	+1·18	+74·7	+72·6	+70·6
22	4·7	6·6	29·6	1·20	62·5	60·4	58.4
23	6·2	6·6	41·7	1·22	50·3	48·3	46·2
24	7·3	6·1	53·9	1·23	38·2	36·1	33·9
25	7·8	5·4	66·1	1·25	26·0	23·9	21·7
26	7·9	4·3	78·4	1·26	13·8	+11·6	+9·5
27	7·5	3·1	90·6	1·27	+1·6	—0·6	—2·8
28	+6·8	+1·8	—102·8	—1·29	—10·6	—12·8	—15·0
29	+5·8	+0·3	—115 0	+1·30	—22·8	—25·0	—27·3

These longitudes are reckoned, according to the custom of selenographers, from the central first meridian 0 both ways, + in the direction of the preceding, — in that of the following edge. As, however, the manner of reckoning has several practical inconveniences and disadvantages, observers of the moon will perhaps not object to a little innovation, which supplies a remedy without interfering with established custom. It is proposed, while retaining or discontinuing at pleasure the employment of selenographical longitudes λ, to introduce the use of their complements $90° - \lambda$, and to call the latter "colongitudes." This term and the notation "$90° - \lambda$," will prevent any misinterpretation or misunderstanding. On the map the colatitude of the preceding edge is 0°, that of the central meridian 90°, and that of the following edge 180°. The convenience of the little innovation will perhaps be most readily tested and appreciated by comparing the table previously given with the following, in which the longitudes are supplanted by their colongitudes :—

	Earth's place. colong.	Earth's place. lat.	Sun's place. colong.	Sun's place. lat.	Colong. of Terminator. 60° N.	Colong. of Terminator. 0°.	Colong. of Terminator. 60° S.
	°	°	°	°	°	°	°
July 9	94·5	−6·7	320·8	+0·92	52·5	50·8	49·2
10	95·6	6·7	333·1	0·94	64·7	63·1	61·4
11	96·5	6·4	345·3	0·96	77·0	75·3	73·6
12	97·1	5·8	357·5	0·98	89·3	87·5	85·8
13	97·5	5·0	9·8	1·00	101·5	99·8	98·0
14	97·4	−3·8	22·0	+1·03	113·8	112·0	110·2
15	97·0	2·4	34·2	1·05	126·0	124·2	122·4
16	96·1	−0·8	46·4	1·07	138·3	136·4	134·5
17	94·9	+0·9	58·6	1·09	150·5	148·6	146·7
18	93·1	2·6	70·8	1·12	162·7	160·8	158·9
19	91·3	4·1	83·0	1·14	174·9	173·0	171·0
20	89·3	5·3	95·2	1·16		Sunset.	
21	87·1	+6·2	107·4	+1·18	15·3	17·4	19·4
22	85·3	6·6	119·6	1·20	27·5	29·6	31·6
23	83·8	6·6	131·7	1·22	39·7	41·7	43·8
24	82·7	6·1	143·9	1·23	51·8	53·9	56·1
25	82·2	5·4	156·1	1·25	64·0	66·1	68·3
26	82·1	4·3	168·4	1·26	76·2	78·4	80·5
27	82·5	3·1	180·6	1·27	88·4	90·6	92·8
28	83·2	+1·8	192·8	+1·29	100·6	102·8	105·0
29	84·2	0·3	205·0	1·30	112·8	115·0	117·3

THE PLANETS FOR JULY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′	″	h. m.
Mercury ...	1st	7 17 55	+24 2	5″·0	0 38·5
	15th	9 6 52	+17 58	5″·8	1 32·0
Venus ...	1st	6 30 39	+23 39½	9″·6	23 47·4
	16th	7 45 16	+22 9	9″·6	0 6·7
Saturn ...	1st	19 20 11	−21 56	16″·6	12 38·7
	15th	19 15 48	−22 5½	16″·6	11 39·3

Mercury towards the middle of the month will be well situated for observation, setting an hour after the sun, the interval decreasing.

Venus is too near the sun to be worth observing. She rises after sunset after the 11th.

Saturn is still very low, but may be fairly observed.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1872.

Clark, Miss
Morton, Rev. J.

To July, 1872.

Loder, E. G.

To Aug., 1872.

Seecomber, Dr.

To Sept., 1872.

Guyon, G.
Jackson-Gwilt, Mrs.
Wright, Rev. W. H.

To Dec., 1872.

Buffham, T. H.
Clark, J. W.
Hubbeosty, Rev. R. C.
Jefferies, J.
Lawton, W.
Squire, H.
Young, L. S.

TO CORRESPONDENTS.

SMYTH'S CELESTIAL CYCLE.—Our Sydney Correspondent, whose exact address we have mislaid, is informed that we can procure a good copy of the above work for him if he still wishes to have it.

We are obliged to postpone several interesting papers through want of space.

NOTICE.—It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 116. AUGUST. 1872.

OBSERVATIONS OF JUPITER FROM DECEMBER, 1871, TO MAY, 1872.

By John Browning, Esq., F.R.A.S.

Read at the Royal Astronomical Society, June 14th, 1872.

From the drawings of Jupiter which I have made since December, 1871, I have selected only four to bring before the notice of the Society. These drawings were made on the following dates:—No. 1 on December 4th, 1871, at midnight; No. 2 on January 14th, 1872, at 7 p.m.; No. 3 on March 3rd, 1872, at 8.45 p.m.; No. 4 May 5th, 1872 at 9.15 p.m.* The drawings made during the winter months are somewhat deficient in detail, as compared with those made recently; but this I do not doubt is principally the result of the bad definition due to very unsteady air, as the first drawing mentioned, that made on December 4th, contains nearly as much detail as those made recently. The markings are, however, so complex that when the air is unsteady they defy all attempts to draw them accurately. I had some tolerably good views of the planet earlier than December of last year, the tawny color of the equatorial belt seemed to me stronger than I had previously seen it. As, however, a well known observer, who had previously made color observations of Jupiter, did not agree with me, I preferred making continued a series of observations before giving a decided opinion on the subject. Subsequent observations have convinced me that my conclusion was correct, and I have since been fortified in this opinion by the statement of our late President Mr. Lassell. On every occasion when the definition has been good, I have been able to make out light markings flecking the tawny colored surface of the equatorial belt. The drawings I have made do not shew any remarkably symmetrical forms. In several instances I had drawn nearly oval markings or turretted forms on the southern edge of the equatorial belt; but using the highest power

* Two of the four drawings are reproduced in colors in the *Monthly Notices*.

the night would bear, and watching for fitful intervals of the best definition, I always found these exceedingly regular forms were incorrect, and had to modify them, for this reason. I rather distrust the drawings made on the 3rd of March, the markings on the dark belt south of the equator present forms similar to those we see at times in white cumulous clouds previous to a thunderstorm. I believe that could I have obtained clearer views of the planet, I should not have left these markings quite so regular as they now appear in the drawings. The light belts frequently incline at a considerable angle from the poles towards the equator of the planet. The belt shown on the drawing No. 4, made on May 5th, at 9.15 p.m., G. M. T. makes an angle of nearly 25° with the equatorial belt; a number of shorter markings also about the same angle stretch some distance into the tawny colored equatorial belt; these I at first drew of a turretted form and only very close examination convinced me that they had the inclination I have now given to them. The darker belts have varied from dark warm or cool grey to purple madder or madder brown, but towards the poles of the planets the belts have been usually of a blueish grey, while close to the poles the blue color has been very decided. I have made several observations of the spectrum of the planet, but though I have 12-in. of aperture, I did not find this sufficient to enable me to see more than the dark absorption bands in the red portion of the spectrum, with which most observers are now probably familar. Though I cannot make out any differences in the appearance of the spectrum sufficiently marked to enable me to draw or describe them, yet I strongly suspect a change in the spectrum which a larger aperture giving more light would enable me to bring out.

NOTICE OF A LECTURE BY PROFESSOR G. B. DONATI ON "AURORÆ BOREALES AND THEIR COSMICAL ORIGIN."

(*Concluded from page* 148.)

Let us consider only the phenomena of auroras. These are produced almost invariably in the polar regions; since there the action of the terrestial magnetism which may combine with the cosmical, whose actiou never ceases to operate in a certain degree, is more energetic; but if such a degree is by some means augmented, it is evident that there will been corresponding augmentation of the auroral phenomena, which will extend themselves so as to become visible even in places more distant from the poles. Donati proceeds to notice the investigations of Wolf in 1859, and Carrington, in his work published in 1863, on the influence of Jupiter on the number of the sun spots; and of Loomis, who has recently taken into consideration the effect of the combined movements of Jupiter and Saturn, which every ten years (very nearly) are found in a straight line passing through them and the sun. There is also another period. Two revolutions of Saturn round the sun are accomplished in nearly the same time as five revolutions of Jupiter, so that in about 59½ years these planets return to exactly the same positions relatively to the sun. These periods have indeed a surprising correspondency with those which we have already remarked as belonging to the greater or less frequency of grand auroras. * * * Science is therefore not adverse to admit that the greater or less development of these phenomena may to a great extent depend upon the simultaneous and combined action of the above mentioned two planets. Donati next refers to a like probable influence in the case of all the other planets, but remarks that the necessary researches to establish this are

both difficult and as yet wanting. He proceeds to observe that the cosmical theory of auroras not only explains their periodicity, but as he thinks, may account for another circumstance connected with them, for which no theory as yet has offered any explanation: that is that for all places however widely differing in longitude, auroras, at least the greater displays, begin always after sunset, attain their maximum between 10 and 11 p.m., and end a little after midnight; the very great ones, however, last even all night. * * * How could this happen if the aurora arose from electric phenomena, dependant only on conditions of our atmosphere? Were it so, it is not intelligible why they should be developed first in the east, and then in the west: why, that is, their phenomena transport themselves successively from one place to another; whilst, on the contrary, the atmosphere should be found in a certain degree of excitement; the maximum for example, in a given instant which ought to be *simultaneous* everywhere; and, consequently, the maximum of the phenomenon ought to be manifested in different hours for those places which at that instant have already night, but different hours of the night: only in different places the phenomenon would be seen in different positions with respect to the horizon.

But if, instead, we admit magnetic cosmical currents, and imagine for example, a certain current going towards or leaving the sun; then it is easily conceived that in our atmosphere (whether *cosmical* or *meteorological*), certain phenomena could only happen in those parts which take a certain position and direction with respect to that current; and, consequently, the various phenomena would successively become visible under the different meridians, as by the divisional movement of the earth those came to assume in succession the same position and direction with respect to the said current. * * * Donati adverts next to the principle of the spectroscope, and its application to investigate the nature of auroras. He says of the bright green line, that not being precisely that of iron, it cannot with certainty be affirmed that where the aurora occurs there are particles of iron present. Nevertheless, the experiments of Mr. Tréve show that the bright lines of certain substances change when they are brought under the action of magnetism; and since the aurora is a magnetic effect, the green line observed in its light might well belong to iron, notwithstanding it be a little displaced from its ordinary position. But it must be confessed data are still wanting for science to speak positively: only, I will say, that it is very probable that in the higher regions of the atmosphere there are many particles and vapours of iron, since the falling stars, minute fragments of cosmical matter, which in general burn and are consumed precisely in those regions, are mostly composed of iron, as is proved by such as having reached the earth, have been chemically analysed.

It is well, lastly, to remark that, from all I have thus far discovered about it, it may be reasonably inferred that there is beginning to rise on the scientific horizon, a *new* (that is, *cosmical*) meteorology, which may not a little aid the progress of that *ancient* meteorology, which although born so long ago, is yet altogether in its infancy.

Florence, February 15, 1872.

RAIN OF SAND IN SICILY.
By Professor G. de Lisa.

Professor G. De Lisa, of the Observatory of Palermo, has printed an account of the great fog and the rain of sand, which occurred in Sicily in March last, from which the following brief notices are extracted.

March 6th.—Unusual meteorological condition of the atmosphere. Slightly reddish aureole round the sun; barom. falling.

7th.—Dense fog; barom. still falling; winds variable, and from S.

8th.—Bar. pressure still lessening; at 9 a.m. a high and dark fog seen above the cumuli, which at 4 p.m. spread over the country; winds chiefly S. and S.W.

9th.—Pressure at a *minimum* of m.m. 745.09; heavens obscured; fog universal; an ashy-reddish colour prevails everywhere; wind strong, S. and S.E.; oppressiveness and languour; sea disturbance; a very fine red dust deposited everywhere; 9 p.m. bar. rising; soon after the air became calm.

10th.—The dense fog continues; at 9 a.m. a great quantity of sand was gathered up on the terraces of the Observatory; the sun seen for a few minutes through the fog with a well-defined white disk, beheld by the unprotected eye with impunity; in the afternoon rain with lightning and thunder; setting sun looked like the full moon in its quiet splendour; 9 p.m. rain mingled with a large quantity of fine dust.

11th.—Dense fog; sun invisible.

12th.—Fog, but not dense as before; it is real vapour of water, and has not the brown colour of the past days.

In general, it is to be remarked that the dense fog while it lasted was very high, more elevated than the hills and clouds. There was nothing very exceptional in the hygrometric state of the air; the highest temperature did not exceed twenty degrees. When the Sirocco blows in Palermo the predominant meteoric conditions are very different from those above noticed. They are not unseldom accompanied by dry fogs. It is evident that a great tempest gave rise to the phenomena we have described.

M. De Lisa next refers to M. H. Tarry, of Paris, who in May, 1870, presented to the Academy of Sciences a note in which he stated that such storms, or *cyclones*, as above described, could be foretold. At certain epochs of the year, and principally in February and March, cyclones are suddenly formed in the North of Europe, and descend rapidly towards Africa, where they form sand-storms in the Sahara, and raise enormous quantities of the desert sand to the higher regions of the atmosphere. Other cyclones are formed in America near the equator, and arrive at the N.W. of Europe . . . whence descending to Africa, they afterwards return from the S. to the N., charged with fresh masses of sand.

Writing to De Lisa on February 28, 1872, M. Tarry remarked that a cyclone which descended on Europe from 24th to 27th January had then its centre on Sicily; and he believed that it would return from the S. about the 3rd *or* 4th *of March*, and that it was very probable that *a fall of sand would be observed in Sicily or Spain*. . . . Besides that this provision of M. Tarry did not fail, there is no doubt that the cyclone observed, and the fallen sand were of African origin. The phenomenon was also observed in the southern parts of Sicily, and the desert sand was abundantly deposited everywhere—a very fine and light powder, and of the colour of pounded terra cotta.

The Professor proceeds to notice various remarkable solar phenomena which occurred on the 5th March, and which were observed in various

places by P. Denza, P. Secchi, and Tacchini ; also fine zodiacal light, auroras, and magnetic perturbations about the same period : observing that in a mass of facts it is necessary to distinguish those amongst them which owe their origin more proximately to solar movements, from others, which though at first they were similarly produced, after a time following their evolutions have lost the importance of such an immediate reference. There is a close link between solar eruptions and auroras, phenomena rapidly developed that do not involve researches for a distant origin. But the study of storms is more difficult. The magnetism of our earth, violently disturbed by the solar movements, must act powerfully upon atmospheric currents, and occasion not light derangements, which when they find favourable local meteoric conditions, give rise to storms which afterwards are propagated everywhere. Here the necessity and the action of time is more important. A storm may be in the vigour of its commencement, when the cause which produced it has already ceased, the greatest circumspection is therefore necessary in treating of such important questions. An example is afforded by this dense fog. Some might think there was an evident connection between it and the solar phenomena, auroras, and zodiacal light observed at the same epoch ; but they would be mistaken. The solar eruptions of the 5th March may very likely originate tempests, even as they have originated auroras, and the strengthening of zodiacal light ; but they have no direct relation to the tempests of those days, which attracted the attention of M. Tarry as far back as the end of February, so that he was able with confidence to predict the arrival of the tempest in Sicily, accompanied by the rain of sand, twelve days beforehand.

A study more minute and accurate of the various cosmical and meteoric phenomena will lead to the splendid resolution of many problems ; and, perhaps, from the appearances of the sun we may be able to deduce the changes which shall affect our earth in not short periods of time.

PROFESSOR DONATI ON THE AURORA OF 1872.

Professor Donati has published a note on "Some Phenomena which manifested themselves on the telegraphic lines during the Great Aurora of the 4th of February, 1872," &c. The following is extracted from the Professor's paper :—

"The accidental currents, and the corresponding perturbations were greater on the lines whose direction is from east to west, than on those whose direction is from south to north ; and that also when the lines from east to west are much shorter than those from north to south. . . . . This fact had been noted by Sig. G. Masi [Inspector] also on the occasion of the great aurora of the 24th of October, 1870 ; and has likewise been confirmed by MM. Sureau and H. Tarry, for the telegraphic lines of France.

Very many, moreover, were the inversions of direction, and very many the changes of intensity that the currents underwent which traversed the telegraphic wires at the time of the aurora. . . . From the things thus far related, I think, then, that I may conclude with M. Tarry that the perturbations of the telegraphic lines were *in general simultaneous*.*

* In Italy, France, and Turkey.

Nevertheless, on this very important point more extensive and minute researches would be desirable, than what have been hitherto made; inasmuch as the perturbations on the telegraphic wires succeeded each other in an almost continuous manner, and even small errors in the time noted, or in the observed deviations, might make a coincidence appear, even where it does not really exist.

To prove the *general simultaneousness* of the electric disturbances which are manifested on telegraphic lines during auroras would be the more important, since it seems sufficiently established by experience that the luminous phenomena depending on auroras are by no means simultaneous, but, on the contrary, are displayed first in the more eastern places, and afterwards in those more to the west.

Donati adds in conclusion that a note he had just seen from M. Troerster, Director of the Observatory of Berlin, confirms the results he has above indicated. In Germany, also, the perturbations were greater on telegraphic lines lying along the parallels, than on those lying along the meridians. There, too, they had inversions of the current, and constant currents, which happened in times corresponding with those observed in Italy, France, and elsewhere. These phenomena, remarks M. Troerster, which appear to have intimate relations, even at very great distances, deserve to be studied, both in a *chronographic* and a *dynamic* respect, with more care than has hitherto been bestowed upon them."

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE NEBULA IN THE PLEIADES.

This object was seen as a large bright nebula in 1859. In the next year Tempel, who had so seen and described it (he had taken it at first for a comet), could just see it with the 6-ft. refractor at Marseilles. If we combine these facts with the circumstance that Mr. Grover, whose acuteness of vision is well known, can only just perceive it with so moderate a power as 150 on a fine 12¼-in. reflector, one does not quite perceive why it should "appear more than ever certain to his mind that we see the nebula now exactly as it has existed for many hundreds and perhaps thousands of years." Even without the known facts which led Sir J. Herschel to include this nebula among variable objects ("cases in which a nebula, undoubtedly such, has either disappeared and reappeared in the same place, or has undergone some remarkable change of brightness") one can scarcely see how the observation of a nebula for 2½ years should make us altogether confident as to its condition "many hundreds and perhaps thousands of years ago." If hundreds and thousands, why not millions and billions of years? I fail to see how the 2½ years can extend themselves so largely without possessing the capacity for extending themselves indefinitely.

Faithfully yours,
FACTS RATHER THAN FANCY.

PROCTOR'S CHART OF 324,198 *STARS.*

Sir,—I am not quite sure whether Mr. Backhouse in speaking of the tendency of stars in this chart to arrange themselves in circles having the pole at their centre, refers to the great rich projections from the Milky Way in Perseus, Auriga, and some other places, or to a more minute and, as it were, textural feature of the chart.

If he refers to the former, I can unhesitatingly say that the feature is a real one, though the actual position of these great star streams is of course a mere coincidence. Wollaston recognised these projections as Milky Way features, and they are recorded in the star maps of the Society for the Diffusion of Useful Knowledge, as also in my Gnomonic Charts, Constellation Seasons, and elsewhere. In my large atlas I discarded them, because I followed Sir J. Herschel's descriptions and drawings of the galaxy, and he did not recognise them. But they exist, and it is not the least remarkable result of the process of charting I employed that not only does it show the Milky Way actually plotted out by stars of the brighter orders of magnitude, which according to the Grindstone Theory of the Universe ought to show scarcely any marked aggregation towards the galactic zone, but it brings out features which can only be recognised by persons possessing extraordinary acuteness of vision.

These results, though according generally with Struve's statistical results, go yet very much farther, and, rightly understood, demonstrate the existence of *real* as distinguished from *optical* aggregations of stars in the milky way region.

But if Mr. Backhouse's remark relates to a minuter feature—an apparent tendency in certain places to concentricity or radiality of stars—then we have to do with a textural peculiarity resulting partly (in all probability) from the way in which the stars of Argelander's series were observed, and partly from the nature of my process of charting. That in different "sweeps" there should have been a greater or less degree of space-penetration will seem by no means unlikely, if we consider how the best observers find their visual powers varying as their work proceeds. There is not uncommonly a gradual increase of power for some considerable time after such work begins, followed after a time by a gradual accession of eye weariness. The effect of this on the charts will be obvious. Then, again, only certain parallels are swept by the centre of the field (Argelander and his assistants used a rather large field), and this would have an effect, though perhaps a slight one.

As to the charting, I would invite those who possess copies of my chart to examine it closely in R. A. 5h. 20m., and about two inches from the circumference. Here they will find traces of the pencilling (the only traces of the kind in the whole map). Now, if they consider that such minute spaces as are here seen were filled in repeatedly by eye-draft from the corresponding spaces in Argelander's chart, they will see at once that no star could by any possibility be set more than the minutest fraction of an inch out of its true place, and they will thus recognise that *for its main purpose* the chart can be implicitly relied upon, it is, indeed, much more accurate than was by any means necessary *for that purpose.* Nevertheless, the possibility of a minute textural peculiarity resulting in certain places will be at once recognised. The circles and radial lines pencilled in before the work of charting began, seemed to the eye perfectly regular, concentric, and truly distanced, but when one sets down hundreds of thousands of stars, in tens of thousands of spaces, the

minutest departure from regularity will reveal itself. Even if the pencil point has been a little blunt at one part of the work, and has so made thicker strokes than elsewhere, the effect will be recognised.

Such considerations will perhaps serve to explain the occasional occurrence of a slight textural peculiarity, which does not in the least affect the main teaching of the map, a teaching which amply repays me for the 400 hours devoted to the construction of the chart.

But even this peculiarity is partly subjective. Let any one cut out a circle about four inches in diameter from a sheet of paper large enough to hide the circular boundary of the map, and place the sheet on different parts of the chart, especially where the peculiarity noticed by Mr. Backhouse seems most obvious, and it will be found that the concentricity or radiality becomes much less startling.

Dr. De la Rue has advised me to get the chart copied of its full size by the photoheliotype process. I fear, however, the cost would be too great, and it need hardly be said that any sale such a chart can have must be quite insufficient to cover the photographic expenses.

Your readers may be interested to learn that the processes of star gauging which the results of my charting led me to suggest are likely to be set on foot on a tolerably extensive scale. I have already received promises from observers using, or about to use, a 20-inch reflector, a 12-inch reflector, and an 8-inch refractor. More recruits, with these and other space penetrating powers, are wanted. There need be no fear of their work overlapping, indeed, it *ought* to overlap, that results may be compared. I hope next spring to complete the survey of the region covered by Taurus, Auriga, Gemini, and parts of Orion and Perseus, with the 4⅜-inch refractor lent me for the purpose by the Astronomical Society. (Surveys with small apertures, from 3½ inches upwards, are as important for completing the evidence as those with the largest.*) But the greatest encouragement I have yet received has come from the Astronomer Royal, who speaks even of applying the powers of the great equatorial at Greenwich to the gauging of the star depths at suitable times. I am satisfied that when once the work has been fairly set on foot, and results begin to be available for study, it will be quite unnecessary for me to urge any arguments in its favour.

RICHARD A. PROCTOR.

SPECTRUM OF THE ZODIACAL LIGHT.

Sir,—In your Number 115, p. 166, you report, with regard to my paper read at the Royal Astronomical Society, and describing my recent observations of the spectrum of the Zodiacal Light at Palermo, that Mr. Proctor (one of the Secretaries of the Society) "thought the observations rather doubtful, from Professor Smyth having used so many as nine prisms. With three or five he would have had a better chance upon such objects." After hearing which damaging statement the Society passed on to the next paper.

For Mr. Proctor's sake, I hope that your reporter has made some error in taking down his remark; but *I* am required to deal with the words

* It is important that the fields of view should be made *square*, so that no vacant spaces may be left. I began gauging with circular fields, thinking the gaps of no importance, but having tested the results against those obtained with square fields I found the former quite untrustworthy.

actually printed by you and already misleading your readers as to the worth of the results arrived at by me, touching an astronomical phenomenon whose exact nature is at this moment a matter of keen disputation all over Europe, and throughout America as well.

Had I used so large a number as nine prisms in any manner in which a spectroscope is ever spoken of in the present day as containing nine prisms,—*i. e.* nine separate pieces of glass, each going on both increasing the dispersion of the previous ones, and decreasing the intensity of the transmitted light by reflection at first and second surfaces of each piece: why, of course, on such originally faint rays as those of the Zodiacal manifestation, there would have been at last at the eyepiece of the instrument so little direct transmitted light, and that so much dispersed, that the result must have been futile.

And so it would have been also with "three or five" such prisms, as stated to have been recommended to me by Mr. Proctor as better than "nine." Quite needlessly too; for I, knowing all that long before, had used only *one* prism of peculiar order, and which I had correctly described in the paper read to the Royal Astronomical Society as a direct "vision prism stick or combination." That *one* such prism was made up indeed of nine pieces of glass, but all of them, in the invariable manner of all direct-vision prisms which I have ever heard of, stuck or cemented together with Canada balsam so as to destroy reflection at the internal surfaces; while one half of the pieces being set so as to decrease the dispersion of the other half, and all of them being of very small angle, the final result was not very different to that of a single ordinary flint prism of 60°, except in the convenience of its application to the phenomenon under examination.

I trust, therefore, you will see, that it was an undeserved libel to say that I used inappropriately so many as *nine* "prisms," and then to undervalue my observations for *that* asserted reason. I may add also, that I have two direct vision prisms very similar in size and shape externally, but consisting internally, the one as above, of nine small angled, cemented pieces, and the other of three of very large angle; and that the former gives both the brighter view and the larger field, with very nearly the same dispersion.

I remain, yours very truly,

C. PIAZZI SMYTH.

15, Royal Terrace, Edinburgh:
2nd July, 1872.

PROFESSOR SMYTH'S OBSERVATIONS OF THE ZODIACAL LIGHT.

Sir,—By some mistake a strange inaccuracy has crept into your report of my remarks, respecting the observations made by Professor Smyth on the zodiacal light. The report runs thus: "Mr. Proctor thought the observations rather doubtful, from Professor Smyth having *used so many* as nine prisms," &c. I expressed a very strong opinion of *confidence in* Prof Smyth's observations. I said just before concluding, *that the only* doubtful point seemed to be whether Prof. Smyth could not have obtained even better results had he used a direct-vision prism of five component prisms, or seven, instead of one with nine component prisms. This I suggested on the authority of our chief spectroscopist, to whom I referred by name.

But obviously, the mere fact that Prof. Smyth saw the continuous spectrum, proved that his direct-vision prism did the work it was meant to do.

I used very strong expressions in favour of the paper before sum marising the results contained in it.

The first part of the report requires also to be slightly corrected. Liais saw a faint continuous spectrum, not a strong one, and the impressions conveyed by the arrangement of the names of the observers are not quite correct. But the gentleman who reported must not be held in fault, for there was a great pressure of time, and I spoke in five minutes what I had proposed to say and read in twenty.

RICHARD A. PROCTOR.

LOGARITHM TABLES.

Dear Sir,—The paper by Mr. Lee Glaisher on Logarithm-Tables to ten figures in Monthly Notices for this month May 1872, p. 258-62, reminds me of a long cherished idea, viz., of printing only the 6th, 7th, 8th, 9th, 10th decimals of logs of every number from 1 to 108,000 in an 8vo. vol., so as to be an auxiliary supplement at moderate cost to the collections of Hutton, Bremiker, Callet, &c., now in general use.

To these might be appended the 6th to 10th decim. of log. sin. and log. tang. for every ten seconds of space ; I should think the whole would not exceed in bulk the ordinary Hutton's logarithm-tables ; omitting the hyperb. logs. course and dist., etc., and retaining the useful formulæ of plane and spherical trigonometry.—Ex. Gr. as in—

	0	1	2	3	4	5	6	7	8	9
1000	abcde	fghik	lmnpq	rstuv	abcde			abcde		
1	*abcde*	*fghik*			11111			22222		
2										

If desired, the 6th to 10th places of differences may be printed thus on the opposite page.

0	1			9
fghik—abcde	lmnpq—fghik	*	*	

Also, the useful log. arc log. sin.; log. tang.—log. arc. for small arcs. The conversion of hyperb. to common logs., and *vice versa* would be much improved by a table of ·001 to ·999 times 2·30258 and ·43429 respectively, taking out *three* figures value at a time, instead of two.

I have much pleasure in forwarding to you this suggestion, as you honoured me with a notice of my paper read before the Society in November last, but which, as on former occasions, the Editor of the *Monthly Notices never even gave the title of;* a voluntary act of suppression which the late Mr. Sheepshanks never exercised towards me or any one else. Thus : *e.g.*, I pointed out in January 'forty-four (M. N. vi. 23) the utility of simultaneous distance-measures of Mars when in opposition from the nearest stars at different terrestrial observatories (*e.g.*, Stockholm and Cape of Good Hope) to obtain the parallax of the sun every ten years, in the stillness of night, with fixed instruments, instead of the seldom, costly, irradiation-affected transits of Venus over the solar disk.

I am, dear sir, yours truly,

74, Offord-road, Barnsbury : S. M. DRACH.
May 29, 1872.

THE TRAPEZIUM IN THE ORION NEBULA.

Sir,—On page 37 of your last volume, you favoured me by inserting a communication having reference to the above object, and I am now desirous of adding a few words to what has already been said on the subject.

That the small stars in the interior of the Trapezium are variable seems very probable; some observers have succeeded in detecting the 5th and 6th (in the order of their brilliancy) stars with telescopes of very moderate aperture, while others have, at different times, failed to discern them. Mr. Thomas Owen, of Manchester, writes, in a letter to me that, with an object-glass of 2⅞-inches diameter, he can frequently see *five* stars in the Trapezium very distinctly. In Webb's Cel. Objs., it is stated that the 5th star has been seen with a telescope of 3¼-inches aperture, but only on occasions when the atmosphere has been favourable for the observation of celestial objects. It would appear, therefore, that this star has, of late years, become brighter than formerly, several observers having succeeded in detecting it with instruments of only 3-inch aperture. A few years ago, there was some correspondence on this subject in the columns of the *English Mechanic*, several gentlemen stating that with a 3-inch refractor they had seen the 5th star on several occasions, while an anonymous correspondent disputed this, and was inclined to consider the object quite out of the reach of telescopes of the aperture stated. It would seem, however, that the star has been actually observed with a 3-inch glass, if we are to believe the statements of observers whose testimony would appear to be reliable. If the smaller stars of the Trapezium are variable, they would, of course, be very difficult objects to make out when at their minimum degree of brilliancy, while, on the other hand, they would be much more conspicuous objects when at their brightest; and, at that time, quite possibly one, if not two, of them could be observed with a 3-inch telescope or even with a smaller instrument. Mr. Owen states, that he can see the 5th *very distinctly* with his 2⅞-inch, and, as he speaks so positively, it is hardly possible that he can be mistaken. In confirmation of the observation to which I have just referred, Mr. R. J. Ryle, of Burton-on-Trent, says that: "On January 6, 1872, while observing the Trapezium in Orion with a 3-in. O. G., p. 80, I was struck with a suspicion of seeing the 6th star. Knowing it requires a larger aperture I should have thought I was decidedly mistaken if I had not received a communication from a friend, at about the same time, saying, he had also suspected he could make out the same star with his *three-inch* telescope." It would be strange, indeed, if both these gentlemen, who are habitual observers, should have been deceived. If not, the 6th star must be very variable; for it was, according to Mr. Ryle, but very little inferior in brightness to the 5th, and was situated in precisely the same position as that assigned to it. Possibly, then, the 6th star as well as the 5th has been detected with a 3-in. O. G. If this is the case (and there does not appear much reason for doubt) the two stars referred to, must necessarily be variable, otherwise they would not have been considered such difficult objects. At any rate, there appears to be strong evidence in favour of the opinion that they are variable.. Mr. John Browning, F.R.A.S, was of this opinion from observations he made in January 1867, and in March of the same year he communicated to the *Register* the results which he obtained. One of the stars (the 5th) which on January 25 was much brighter than another small star seen by him in the Trapezium was scarcely perceptible three days afterwards, and he was quite satisfied that

the stars had undergone a change in their brilliancy. From this, he inferred their variability, and this idea is strengthened by the other observations of which I have spoken. Certain it is that, until quite recently, the 5th star was quite out of the reach of a 3-inch O.G., and the 6th being even fainter, was scarcely visible in a telescope under 4 or 4½ inches aperture, while they have now been observed (*and the observation verified*) with a 3-in. and 3½-in. refractor. It is necessary, therefore, in order that we may become better acquainted with the extent and periods of the changes which occur in the amount of light emitted by these minute stars that they should be carefnlly examined on all favourable occasions. There are very many, indeed, of the readers of your valuable journal, who possess powerful instruments, and if some of them would frequently examine the Trapezium (when favourably situated for observation) their results would, no doubt, be found to be valuable. It does not appear that, during the last few years this most interesting object has been much observed by those who possess telescopes of large aperture. A systematic series of observations of the relative brilliancy of the small stars in this exquisite object (conducted on the same plan as the observations which have recently been made of the lunar crater Plato) would, no doubt, lead to our soon deciding the question as to whether or no they are variable. I hoped to be able to obtain some observations of the Trapezium myself last winter, but did not do so. Perhaps there are some amongst your subscribers who were more successful. If this is the case, perhaps they will send the observations to the *Register* for insertion, for there can be no doubt that the Trapezium in Orion is one of the most interesting objects for telescopic examination.

Believe me, dear Sir, your obedient servant,

WILLIAM F. DENNING,

Hon. Sec. Observing Astronomical Society.

Hollywood Lodge, Cotham Park, Bristol:
June 6, 1872.

NEW DOUBLE STAR, 6 *SERPENTIS.*

A few evenings since I discovered the existence of a close companion to 6 Serpentis with my 6-inch Alvan Clark refractor. This star is not included in any of the catalogues of double stars I have, and was certainly missed by the Struves. The magnitude of the companion is about the same as the companion to 5 Serpentis (10 of Struve's scale), and the distance I estimate about 3″. It is not a difficult object with a six-inch aperture. The place of the star 600,870 is R.A. 15h. 14m. 25s.; N. 1° 11′. I hope astronomers will observe this fine pair, and report results with measurements or otherwise.

S. W. BURNHAM.

Chicago: June 20th.

NEW DOUBLE STARS.

I would ask the attention of observers to the following new double stars found within the last three weeks with a six-inch Alvan Clark refractor. The places are for 1870.

OPHIUCHUS. Weisse xvii, 296, 17h. 17m. 39s.; N 13° 31′. The companion is very small at a distance of about 3″ from the primary *sp*. The principal star is of the 8 magnitude. This is 1m. 36s. preceding Σ 2159, a wide and easy pair (D = 26″, P = 326°).

LIBRA. Weisse xv, 424, 15h. 24m. 5s. S 12° 33′. This is a quadruple, or double-double star, the two pairs being about the same distance apart as the components of ϵ Lyræ. The primary is of the eight magnitude, and the companion perhaps 11 magnitude. The other pair is composed of 10 or 11 magnitude stars, the distance of each pair being about 3″.

BOOTES. Arg. (+20°) 2904. 13h. 51m, 57s. N 20° 5′. 8.9 magnitude. The companion is very faint, perhaps 14 of Smyth's scale, and distance not much exceeding 5″. It precedes Σ 1797 3m, 50s., and is *sp* Σ 1794, the three forming a triangle. The first pair from Struve is wide and very easy, the distance of the other is 1″.9, but the components being nearly equal, it is not difficult. These pairs are all *nf n* Bootes.

I notice in the *Register* for March a letter from Mr. Holden in reference to the faint stars near ϵ Lyræ. I found last year a star with a very faint double companion a short distance following. This star is readily found without an equatorial mounting since it is only necessary to place ϵ^1, the northernmost of the two pairs, in the instrument and wait 1m. 20s. when the star in question will be found in the field. The magnitude of the primary is given by Argelander as 8.8. The companion is composed of two 10 magnitude stars about 2″ apart at a distance of 90″ from the primary. Though perhaps not very interesting as a double star, the duplicity of the companion makes a fair test object for a small aperture, and so far as I know, it has not been noted before. There is a similar but more difficult triple 6m. 15s. exactly *p* ϵ Lyræ. This star is about 4′.7 south of a 6 magnitude star (B.A.C. 6357) and is easily found. Another excessively faint and moderately close pair will be found 12′ almost exactly north of the triple μ Herculis. The components are of the 11 mag. and about 2″ apart. With my aperture contracted to 3-in. I fail to see the the star at all, but with 3½-in. it is tolerably plain as a single star. This pair is 22s. *p* an 8½m. star, having a distant companion *p*. Perhaps none of the objects named in this paragraph are of sufficient interest to entitle them to be catalogued, but I give them for what they are worth.

I would also call attention to 2 Scorpii and 12 Scorpii. the first a very pretty double, and neither difficult; and particularly to 13 Delphini, 20h. 41m. 22s.; N 5° 32′, a splendid close pair, all discovered with the same glass last year. I looked at the last a few evenings since and compared it with γ Equulei (discovered by Mr. Knott), and found it, but little, if any, more difficult. The distance is but little greater than 1″ and the companion about 10 magnitude. The distance of Mr. Knott's companion to γ Equulei is given in "Celestial Objects" as 2″.2, and perhaps under some circumstances it might be more readily seen. I hope that some of the readers of the *Register* will give these objects attention, and publish observations and measurements if any are made.

In conclusion I may say that the double stars mentioned, and many more found within the last two years, have been referred to all the catalogues I have access to, and are new so far as I have been able to learn. I have Struve's *mensuræ micrometricæ;* Otto Struve's "Catalogue of 514 Double Stars"; Vol. xxxv. Memoirs of the R.A.S. containing Dawe's measurements, and Sir William Herschel's Catalogue, and some works of general character, like Webb's "Celestial Objects." Should any correspondent know of earlier observations of any of these pairs, I should be glad to have the facts stated.

S. W. BURNHAM.

Chicago: June 22nd.

CONNECTION OF METEOROLOGY AND ASTRONOMY.

Sir,—"Another Observer" is only treating us again to his old invention of "Astro-meteorology," as a medium for his profundities. I am no more an admirer of that system than he, and have as little wish to be an advocate of its crudities and imperfections. If, before rushing into print, *he* had been at the laudable pains of making the slightest acquaintance with his subject, he would have known that the well-founded suppositions of some connection between solar disturbances and weather changes, and "planetary conjunctions and oppositions," were no mere platitudes of mine, but have been for years past the opinions of many amongst our best astronomers and physicists. He need even go no further than last January's *Register*. Has "Another Observer" ever heard of the Wanstead Flats? He would find there a much more fruitful field for cultivation than the "debatable land" between the Goodwin's and Tenterden steeple, where, like Mahomet's coffin, his ideas appear to have been too long hovering.

As to the "nine days" hypothesis, I am not aware of having even hinted at such a thing. I certainly, too, have "casually heard" that there have been other conjunctions and oppositions besides those of last January, to which if he had also referred the barometer curve, he might perhaps have found that in by far the greater number of occasions both the barometric disturbance and the other features of which it is the index, occurred in their intensity on the exact days of such oppositions, &c. Your correspondent is doubless not also aware that there are many occasions of storms, &c., of which the barometer gives no indications whatever, when (to quote the words of Mr. Galton, F.R.S., at the B.A.) "inquiry in respect to ordinary English gales, showed the barometer to be worse than no guide at all!" Now, it is this very deficiency that the union of meteorology and astronomy seems to do away with. Moreover, if his objection to a four days period is of any worth, then of what earthly use is there in our expending 10,000*l.* per annum in building up a system of averages of *five*-day periods and areas of hundreds of miles, through and over which a ship might go nine times out of ten without meeting the average condition at all, or, as in the case of the Telegraph Expedition of 1858, might be nearly storm-foundered in a period and area *where such a storm was shown by these very five-day averages to be impossible of occurrence!*

Now, it is this very uncertainty and defect which the assistance of astronomy supersedes. In regard to oppositions and conjunctions there is no more notable instance of their action and reality than the great storm of November 27, 1703. Speaking of the influence of planetary attraction upon the sun's envelope (*Belgravia* November, 1868, p. 120), Mr. Pattison, C.E., alluded to the probable great crisis which it would undergo should all the planets ever become situated on one side of it (*i.e.* in conjunction). Now, it is remarkable that something of this sort took place on the above date in 1703, when the planets were in the following positions:

♃——⊕ ☽——♀——⊙— ☿——♂

Six of the planets were thus in a direct line, and upon such an occasion, if there be any reality in the connection of conjunctions and oppositions, with the disturbances in our own atmosphere, we are bound to expect most remarkable meteorological phenomena. History does not record the grand appearances upon the sun's surface, but the records of the time tell us that on the *exact day* of the completion of this great group of con-

junctions and oppositions, the most frightful storm ever remembered before (or since) swept France and England. "It was not," say contemporary chronicles, "as usually happens, a short and sudden burst of tempest, lasting for a few hours, but a fierce and tremendous hurricane of a week's duration, which attained its utmost violence on November 27. The affrighted inhabitants took refuge in their cellars, and many thought that the end of the world had arrived."

We see from the foregoing that the storm began about the time that the earth was approaching the forming line of planets, that it increased as that line became more complete, and attained its intensity on Nov. 27, the *exact day* when the planets made their nearest approach to a direct line with the earth. If they knew as much then as we do now, they might (in spite of the "what earthly use" of "Another Observer") have prepared in some way for the probable visitation, and thus averted some of the disasters at least which ensued. As it was, our bill of damages comprised 800 houses, 400 windmills, 250,000 timber trees blown down, 100 churches unroofed, 300 sail lost on the coast, 900 small craft in the Thames, 1500 sheep, besides cattle, drowned by the overflowing of the Severn. The loss in London was over a million sterling, and Sir Cloudesly Shovel with his fleet in the Downs, lost three ships of 70 guns, one of 64, two of 56, and one of 46 guns, besides 1,500 men, amongst whom was Rear-admiral Beaumont, who perished with others on the *Goodwin Sands*. Winstanley, the builder of the first Eddystone lighthouse, was so well assured of his building, after it had braved the storms of four winters, that he declared "he would like to be in it during the greatest storm that ever blew under heaven!" The wish was fulfilled, as he was in it on November 27, 1703, when the whole structure was blown into the ocean, with its builder and five men.

Fortunately such astronomical conjunctions and oppositions are rare, but, as said by "Another Observer," there are others of a lesser character besides those of last January. Few of them would be found but what would present meteorological extremes of a corresponding ratio of destructive intensity. Those of January were chiefly remarkable for occurring in pairs, the two oppositions of Jupiter and Uranus occurring within four days, an event which, if my memory serves me, is sufficiently rare to account for the rare phenomenon which followed it.

As I stated in my first letter, I do not bring forward these facts as being *conclusive* upon any point; we are yet only on the threshold of inquiry, but I deem the suggestion of Colonel Strange a step in the right direction, as leading to an ultimate appreciation of the connection which exists between astronomy and meteorology.

I read with very much pleasure the letter of Mr. Elvins on this subject. As he has stated (Toronto *Daily Telegraph*, Oct. 24, 1870) that "efforts to foretell the weather by the moon's age, the planets' positions, &c., have resulted in failure, * * let us see if a better fate will await us when we appeal to the sun," I should have liked to have tested the question with him, but must forbear till another opportunity.

Yours respectfully,

July 12, 1872. OBSERVER.

NAKED-EYE OBSERVATIONS OF MERCURY.

Sir,—Referring to a letter by Mr. Lawton in this month's *Register*, in which he speaks of only seeing Mercury once last spring, I believe the planet may be more often caught with the naked eye than is generally supposed, especially if one will look out for the morning as well as the

evening apparitions. I have never seen Mercury in the mornings, but have been able several times to detect him with the naked eye after sunset—three times in April, 1858, three times in March, 1860, three times in February, 1862, once in April, 1865, once in February, 1868, once in April, 1871, and twice last spring. The observations of February, 1868, was on the 19th, not the 15th, about which Mr. Lawton speaks, though I find from my note-book that the 15th was a very fine night with us in Lancashire. In the *Register* for March, 1868, page 74, it is mentioned that Mercury was magnificently visible on the 15th, in the neighbourhood of London, and below that is a remark from Mr. Walker, of Teignmouth, about its brilliance on the 19th. Dr. Dick in his "Celestial Scenery" speaks of seeing Mercury with the naked eye three or four times. In Humbolt's "Cosmos," there occurs the following passage about the planet, "If we remember how much, from the earliest times, the Egyptians were occupied with the planet Mercury (Set-Horus), and the Indians with their Budha, how under the clear sky of western Arabia the star-worship of the tribe of the Asedites was directed exclusively to Mercury, and that Ptolemy, in the 9th book of the 'Almagest,' was even able to avail himself of fourteen observations of that planet, extending back to 261 years before our era, and belonging in part to the Chaldeans, we shall be surprised that Copernicus, who lived to attain his seventieth year, should have had to complain on his death-bed, that, much as he had tried, he had never seen Mercury. Nevertheless, the Greeks designated this planet, and justly so, "the strongly sparkling" (στιλβων) on account of its occasional intense light. Referring to a communication from Mr. Elvins in this month's *Register*, on a different subject, I do not think I can bear out his supposition of 1871 being a cloudy year, as I find from my note-book that it contained a far larger number of clear nights than any year since 1858, with the single exception of 1870.

Upton Helions Rectory, Yours truly,
Crediton: July 2. S. J. JOHNSON.

MERCURY.

Sir,—Permit me to refer Mr. Lawton to the footnote on page 42 of the second edition of Webb's admirable "Celestial objects for common telescopes;" as also to page 106 of vol. 2 of the *Astronomical Register*, for a notice of an observation of my own on Mercury, made on April 19th, 1864, with my 4·2 inch Ross equatorial. I enclose a fac-simile tracing of the original sketch, taken *ad naturam*, at the time, in my observatory book,

And have the honour to be, Sir,
Your obedient servant,
WILLIAM NOBLE.

Forest Lodge, Maresfield, Sussex.
July 15th, 1872.

REPLIES TO QUERIES.

Dear Sir,—I send the following remarks in reply to the letter of "A Subscriber," in the July *Register*.

The total solar eclipse visible in England next preceding the one of May 3, 1715, occurred, according to Ricciolus's Catalogue of Eclipses, which is contained in Ferguson's *Astronomy* (1772), on July 12, 1684. In addition to this eclipse, there were two others visible between 1715 and "the black Saturday of 1433." These took place on April 6, 1540 and on October 3, 1633.

In regard to the second query of "A Subscriber," I may say that a "3-in. achromatic *is* sufficient to show indications of the markings on Mars about the time of an opposition." Mr. Charles Grover has succeeded in detecting and delineating the general markings on the planet (see *Register*, April 1867, p. 91) with a refractor of only two inches aperture. Mr. John Joynson was also enabled to make (at the opposition of Mars in 1862) no less than 92 drawings of the markings, although he employed a telescope of only 3½ inches. With an O.G. of 3 inches aperture, it would be perhaps impossible to see the precise form of the markings, but no doubt a tolerably good view of their general appearance may be obtained.

I am, dear sir,
Hollywood Lodge, Cotham Park, Bristol: July, 1872.
Your obedient servant,
WILLIAM F. DENNING.

QUERY—JUPITER.

Is there any evidence of the planet Jupiter giving out more light than he can have received from the Sun?

I. G.

SUN.

Greenwich, Noon. 1872.	Heliographical western longitude of the centre of		Heliographical latitude the sun's disc.	Angle of position of the sun's axis.
	°		°	°
Aug. 1	195·35	+213 δ ξ	+5·97	11·30
2	208·59		6·04	11·70
3	221·83		6·11	12·09
4	235·07		+6·17	12·48
5	248·31		6·23	12·86
6	261·54		6·29	13·24
7	274·78		6·35	13·62
8	288·02	+220 δ ξ	6·41	13·99
9	301·25		6·47	14·36
10	314·49		6·52	14·72
11	327·72		+6·57	15·08
12	340·96		6·62	15·44
13	354·19		6·67	15·79
14	7·43		6·72	16·13
15	20·66		6·76	16·47
16	33·89		6·81	16·81
17	47·12		6·85	17·14
18	63·56	+230 δ ξ	+6·89	17·47
19	73·59		6·92	17·79
20	86·82		6·96	18·10
21	100·05		6·99	18·42
22	113·27		7·02	18·72

23	...	126·50		...	7·05	...	19·03
24	...	139·73		...	7·08	...	19·32
25	...	152·96		...	+7·11	...	19·61
26	...	166·19		...	7·13	...	19·90
27	...	179·41		...	7·15	...	20·18
28	...	192·64	+240 $\delta\xi$	...	7·17	...	20·45
29	...	205·87		...	7·19	...	20·72
30	...	219·09		...	7·20	...	20·99
31	...	232·31	+243 $\delta\xi$	...	7·21	...	21·25

Assumed daily rate of rotation, 14°·20 + $\delta\xi$.

MOON.

Libration. Sun's Place. Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* | *Sun's* centre in the zenith. Greenwich, Midnight.

Terminator. Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.

1872.	colong. °	lat. °	colong. °	lat. °	60° N. °	0° °	60° S. °
					Sunrise.		
Aug. 9	96·55	—4·99	339·70	+1·41	72·2	69·7	67·2
10	96·90	—3·90	351·93	1·43	84·4	81·9	79·4
11	96·97	—2·59	4·15	1·44	96·7	94·1	91·6
12	96·70	—1·10	16·36	1·45	108·9	106·4	103·8
13	96·05	+0·50	28·57	1·47	121·1	118·6	116·0
14	94·98	2·10	40·76	1·48	133·3	130·8	128·2
15	93·53	3·62	52·95	1·49	145·5	143·0	140·4
16	91·74	4·91	65·14	1·50	157·7	155·1	152·6
17	89·73	5·88	77·32	1·51	169·9	167·3	164·7
18	87·69	6·43	89·50	1·51	Sunset.		
19	85·79	6·54	101·68	1·52	9·1	11·7	14·3
20	84·21	6·20	113·86	1·52	21·2	23·9	26·5
21	83·07	5·48	126·05	1·53	33·4	36·0	38·7
22	82·43	4·46	138·24	1·53	45·6	48·2	50·9
23	82·30	3·22	150·43	1·53	57·8	60·4	63·1
24	82·64	1·86	162·63	1·53	70·0	72·6	75·3
25	83·36	+0·45	174·84	1·53	82·2	84·3	87·5
26	84·38	—0·95	187·06	1·53	94·4	87·1	99·7
27	85·60	—2·29	199·28	1·53	106·6	109·3	111·9
28	86·94	—3·50	211·50	1·53	118·8	121·5	125·2
29	88·31	—4·57	223·72	+1·53	131·1	133·7	136·4

Query: Which point or spot near the middle of the moon's disc is practically the best adapted for serving as a fundamental mark in selenographical investigations?

The best determined point on the moon's surface is the centre of the

crater Moesting A (in lat. 3° 11′ and long. 5° 13′, or colong. 95° 13)′, which has been used as the mark of reference in the Kœnigsberg observations for the investigation of the moon's librations. Bessel selected this crater in preference to others, because, as he states (Astron. Nachrichten, vol. 16, p. 276), "it appears, *even* in full moon, very bright, and in sharply defined form, and also because it may, by means of its surroundings, be easily distinguished from other similar craters, so that the observer is not exposed to the risk of mistaking it." Bessel made his selection on March 31, 1839, two nights after full moon, and there is no question that for some days before and after full moon, when the crater is fully lighted up, it makes a very good mark. But it seems very questionable whether nearer the times of first and last quarter, when the interior of the crater is partly shaded, its centre can be correctly estimated without considerable difficulty. Will observers of the moon who have the opportunity please watch and sketch the appearance of this crater under its different illuminations? And will they please try to find a really *better* mark, if it exists? Maedler suggested (Astr. Nachr., vol. 15, p. 12) the crater Triesnecker B, but its variable appearance tells likewise against it.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN AUGUST, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists for May and July, 1871, may be employed for the selection of objects suitable for observation in August, 1872. On p. 150 of the June number of the present volume, the value of supplement ☾ — ☉ on May 21, 1871, is given as 152° 21.′ On August 6, 1872, the value of supplement ☾ — ☉ will be 151° 21.′ In vol. ix., pp. 172, 173, the values on July 20 and 31, 1871, respectively were 142° 24·8′ and 1° 32′·7. In 1872, on August 13, supplement ☾ — ☉ = 1° 50′·4. The two lists are therefore available from August 6 to 18 of the present year.

Eighth Zone of objects from North to South.

Palus Somnii, Guttemberg, Magelhaens, Colombo, Sautbech, Borda, Metius, Fabricius, Janssen,(*a*) Rosenberger.

The eastern boundary of the preceding seven zones was printed in the last communication as 25° of west longitude. It should have been 45°, which would, according to the suggested admirable alteration, for some purposes be 45° from the western or preceding limb at mean libration. The present zone extends 5° further eastward, *i.e.*, to 40° west longitude, or 50° from the preceding limb at mean libration. The objects will be coming into sunlight on the 7th astronomical reckoning, and may be looked for on the evening of the 8th, when the moon is about four days old. As the autumn approaches the early moon has decreasing altitudes in the western sky, but this disadvantage is compensated by the much greater facilities for observing the objects in the eighth zone under the setting sun during the first four days after full moon, and it is recommended that advantage be taken of the harvest and hunting moons for observing the objects in the eight zones.

It is suggested that particular attention be given to Gassendi under *every* illumination, several gentlemen have had it under observation for some months past, and additional observations will be valuable.

(*a*) See list for September, 1871, vol. ix., p. 217.

ASTRONOMICAL OCCURRENCES FOR AUGUST, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passge.
		h. m.			h. m. s.	h. m. Saturn.
Thur	1	 23 36	Sidereal Time at Mean Noon, 8h. 41m. 36·14s. Conjunction of Moon and Mars, 2° 17′ S.			— 10 27·4
Fri	2	16 5 23 50	Conjunction of Sun and Jupiter Conjunction of Moon and Uranus, 3° 27′ S.			10 23·2
Sat	3	21 45 17 39	● New Moon Conjunction of Moon and Jupiter, 3° 55′ S.			10 19·0
Sun	4	7 15	Conjunction of Moon and Venus, 3° 28′ S. Saturn's Ring: Major Axis=41″·19 Minor Axis=17″·00			10 14·8
Mon	5		Sun's Meridian Passage, 5m. 41·43s. after Mean Noon			10 10·7
Tues	6	2 10	Conjunction of Moon and Mercury 7° 45′ S.			10 6·5
Wed	7					10 2·3
Thur	8					9 58·1
Fri	9					9 53·9
Sat	10	9 43	Near approach of 96 Virginis (6½)			9 49·7
Sun	11	17 52	☽ Moon's First Quarter			9 45·6
Mon	12	9 47	Occultation of λ Libræ (6)			9 41·4
Tues	13					9 37·3
Wed	14					9 33·1
Thur	15	15 50 7 50 8 53	Conjunction of Moon and Saturn 3° 7′ N. Occultation of 6 Saggittarii (2½) Reappearance of ditto Illuminated portion of disc of Venus = 0·992 Illuminated portion of disc of Mars = 0·982			9 29·0
Fri	16					9 22·8

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	17		Sidereal time at Mean Noon, 9h. 42m. 41·03s.			9 20·7
Sun	18	8 53	○ Full Moon			9 16·5
Mon	19		Sun's Meridian Passage, 3m. 18·78s. after Mean Noon			9 12·4
Tues	20	8 51 9 28 10 8 11 11 13 22	Occultation of 30 Piscium (5) Reappearance of ditto Occultation of 33 Piscium (5) Reappearance of ditto Near approach of B.A.C. 17 (6)			9 8·3
Wed	21	14 5 15 1	Occultation of 26 Ceti (6½) Reappearance of ditto			9 4·2
Thur	22					9 0·1
Fri	23	2 53 12 57	Conjunction of Venus and Mercury, 6° 29′ S. Conjunction of Uranus and Mars 0° 30′ N.			8 56·0
Sat	24		Saturn's Ring: Major Axis=40″·32 Minor Axis=16″·82			8 51·9
Sun	25	8 34	☾ Moon's Last Quarter			8 47·8
Mon	26					8 45·7
Tues	27					8 39·6
Wed	28					8 35·6
Thur	29					8 31·5
Fri	30	7 51 9 12 17 29	Inferior conjunction of Mercury Conjunction of Moon and Uranus 3° 38′ S. Conjunction of Moon and Mars, 3° 18′ S.	3rd Oc. R. 1st Sh. I. 1st Tr. I.	15 36 16 1 16 55	8 27·4
Sat	31	11 41	Conjunction of Moon and Jupiter, 4° 12′ S.			8 23·4
SEPT. *Sun*	1	19 53	Conjunction of Moon and Mercury, 8° 57′ S.			8 19·3

THE PLANETS FOR AUGUST.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	10 32 21	+ 7 56	7″·2	1 50·4
	15th	11 1 28	+ 2 11	9″·2	1 24·4
Venus ...	1st	9 7 22	+17 52	9″·6	0 25·7
	15th	10 15 22	+12 21½	9″·8	0 38·5
Saturn ...	1st	19 10 45	—22 16	16″·6	10 27·4
	15th	19 7 18	—22 23	16″·4	9 29·0

Mercury may be observed at the beginning of the month as an evening star, setting on the 1st about 48 minutes after the sun, the interval decreasing.

Venus is still too close to the sun to be well observed.

Saturn may be fairly observed till after midnight, setting at the beginning of the month two hours and a half after midnight, the interval decreasing at the end of the month to about half an hour.

REVIEW.

Essays on Astronomy. By Richard A. Proctor. Longmans, Green & Co., 1872.

We are glad that Mr. Proctor has determined to publish in a collected form some, if not all, of the many articles and notices which have appeared from his clear and running pen in the various serials and reports of the societies. In the present volume he has gathered together a number of essays upon more strictly scientific subjects, and he promises a second volume of a somewhat lighter kind, and more closely associated with the subject of the plurality of worlds. There are in the present volume three interesting articles upon Sir John Herschel; others on the planets Mars and Saturn (beautifully illustrated); meteors; the zodiacal light; the Sun's corona; coloured suns; Sirius, &c. Some of the more abstruse subjects have been been put into the appendices, among which we may notice an able paper upon the transit of Venus in 1874. Mr. Proctor, in answer to those who profess to object to popular science, and who would imply that, because he has done so much to make science popular, he necessarily has written in a superficial way, says that he has never written anything in the popular serials upon any subject that he had not previously treated more solidly. This is always borne out by the dates of the various essays. We believe that he has done much to incite an interest for these subjects among those, who under ordinary circumstances, would not have dared to encounter the difficulties

and labour of learning, and by so doing, we feel sure that he can have done no harm, and that he has really enlisted many valuable hands in the service of science. We shall be happy to hear that the success of this volume induces Mr. Proctor to give us more.

SALE OF A LARGE ACHROMATIC.—The great refractor, by Cooke and Sons, of York, which was shown at the International Exhibition of 1871, was sold by auction by Messrs. Stevens, of King Street, Covent Garden, on the 12th ultimo, for about 750*l.* The instrument, which had every modern appliance, and was one of the most complete ever turned out by these celebrated makers, was of 10 inches clear aperture, and was originally priced at 1,200*l.*, but owing to the rise in wages and materials would now be charged much more. The purchaser was Mr. Henley, the telegraph engineer.

Errata. In list of subscribers for *Seecomber* read *Seccombe*; for *Hubbeosty* read *Hubbersty*.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1872.
Rivaz, Miss.

To July, 1872.
Ormesher, H.

To Sept., 1872.
Hendry, W.

To Dec., 1872.
Andrews, W.
Crowe, Rev. R.
Glover, E.
Gooch, Miss.
Lance, G. A.
Lewis, R. T.
Locke, W.
Metcalfe, Rev. W. R.
Nelson, E.
Noble, Captain.

To June, 1873.
Gladstone, Murray.

TO CORRESPONDENTS.

Smyth's Celestial Cycle.—Our Sydney Correspondent, whose exact address we have mislaid, is informed that we can procure a good copy of the above work for him if he still wishes to have it.

Notice.—It is particularly requested that all communications be addressed to the Editor, Parnham House, Pembury Road, Clapton.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to John C. Jackson, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

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THE BRITISH ASSOCIATION AND LUNAR WORK.

"He that putteth his hand to the plough and looketh back!"—we know the rest. Twenty years ago the British Association for the Advancement of Science put its hand to a work of no small magnitude and of no little importance. Unostentatiously it sought to throw light upon bygone Selenological changes through the instrumentality of accurate *drawings* of portions of the moon's surface; and some delineations of Gassendi, Plato, and the Mare Crisium, were executed by members of the first Lunar Committee. After a repose of eight years a partial revival took place, and a report was presented embodying some observations of the Crater Plato, in the course of which several objects in and around Plato were particularly examined. Four years later the energies of the Association were directed to a much greater work: the compilation of a catalogue of lunar objects accompanied by critical and explanatory notes, and assisted by a grant from its funds. The few following years, 1865 to 1868, witnessed an extension of the work, by the projection of a map on the scale of 200 inches to the moon's diameter, and during the four years four sections or areas of 5° in latitude and longitude were produced. These areas included every object that could be detected with ordinary telescopes, or found on existing photograms. At the meeting of the Association in 1868, objections were made to the great extent of the work and to the necessary slowness of its progress, which it was considered rendered it unsuitable for receiving the assistance of the Association, and, in consequence, the Committee was not reappointed at that meeting. Two years later the Association took up another line of lunar research, viz., the discussion of observations of lunar objects suspected of change, which has been continued for two years. The first year's work has been confined to an examination of the observations of the spots on the floor of Plato, and the second year's work to a similar examination of the observations of the streaks and markings on the floor. We find that the

Committee for carrying on these discussions has not been reappointed, and thus for the fourth time the Association has withdrawn from lunar work.

Of what value is this work which has been taken up in so desultory a manner by the British Association? On reviewing its progress we find in the first instance certain drawings produced, those which were published being three views of the Mare Crisium, by Professor Piazzi Smyth, under the morning, mid-day, and evening illuminations. An interesting series of unpublished drawings of Plato and the Alps are in existence. The labours of the revived Committee, in 1860, were confined to a single report. Much more work appears to have been effected by the Committees of 1864 to 1868. Nearly 500 objects on the four areas included by 10° of south latitude and 10° of west longitude, have been critically examined, and their outlines laid down on the scale above-mentioned. The catalogues of these objects, we are informed in the Report of 1869, contain numerous selenographical and selenological notices, having reference to the sequence of events, such as the protrusion of mountains, the formation of valleys, the appearance of ancient regions containing the remnants of grey plains and mountain ranges, which degrading agencies have so modified as to occasion them to present a very different aspect to that which we find characterising formations of a much more recent period, but still remote in selenological time; in fact, the Committee appear to have treated the subject they had in hand much as geologists have treated geological phenomena. Although a lunar survey of this kind must necessarily be one of great labour, consuming a large amount of time, the fixing of the lunar features to a definite epoch is of such great value in selenographical researches, that it is a matter of regret that it has been discontinued, especially as the amount of the grant never exceeded 120*l.* annually. One important result has grown out of this work, viz., the possibility, if not the probability, of detecting the changes occurring on the moon's surface by which *deep* craters such as Linné, previously described as "very deep," have disappeared as if they had been filled up, has led to a very close inspection of the Crater Plato, which has been the subject of the most unremitting attention for at least two years. The discussion of the observations of Plato is the last work of the Association connected with the moon; it has shown that small spots varying in intensity of brightness and visibility are numerous on the floor, and that the streaks and markings which appear to be intimately connected with the spots, are also variable in form and brightness. The most striking result, however, is the darkening of the floor as the sun attains his greatest altitude above the horizon of Plato. These are certainly results which are leading us on towards a clearer conception of the state of the surface, and must contribute to the formation of views of the operation of forces, modifying that surface, of a character much nearer the truth than those formerly held.

So far as we are able to learn, the Association has withdrawn from this important work on account of its magnitude. The mapping of the surface in the way proposed consuming so large an amount of time, that its completion cannot be expected within any reasonable period, and with regard to the work, not less important, of observing definite portions of the disc, it may be remarked that, in order to detect such changes as the last Committee in its two reports has indicated, it is a work of considerable labour, and much time must be consumed in making the necessary observations. Now, it may be worth while to enquire if reasons such as these ought to weigh in retarding a work that promises to be of great benefit to *future* Selenographers? In the first place, no great work can

be proceeded with except it be step by step; each portion must be made good before the next is attempted, and if the aphorism—

> "By many blows that work is done
> Which cannot be achieved by one,"

be kept steadily in view, and the main object not allowed to sleep, progress must result. Had the Association continued its grant, even if reduced to £100 *per annum*, it is more than probable that, by this time, four more areas of the map would have been completed, and a larger number of objects catalogued, and, as regards observations, we have reason to believe that by pursuing a course similar to that adopted by the last lunar Committee, a large number might be obtained capable of yielding important results. If these views be correct, it appears that the proximate effect of the withdrawal of the Association from the work has tended to retard it. Nevertheless, so far as the grants have been judiciously applied, the Association has been true to its designation; it has advanced the science of Selenography. In the second place, because the Association has withdrawn, and the work has been proportionately retarded, are we to come to the conclusion that it will languish and die out? By no means,—languish it may, but if there be energetic and devoted Selenographers, and they are upon the increase, the study of lunar physics will assuredly not die out. Observers will not be content with the works of Schröter, Gruithuisen, Lohrmann, Madler, Smidt, and Bulard, but will seek in some way to bring their own work before the public, to place their observations on record, and to secure an examination and discussion of them, that their labours may not be lost, but that posterity may reap the benefit, should they not meet with a favourable reception at the hands of living astronomers.

HISTORICAL ECLIPSES.

Mr. J. R. Hind, writing from Mr. Bishop's Observatory, Twickenham, furnishes us (*The Times*) with the following interesting sketch of the Eclipses recorded in History:—

"It is well understood that the historical eclipses, especially those of the sun, have an important bearing upon our knowledge of the elements of the moon's motion, as affording the means of testing the accuracy of those elements when carried back to very remote times. I send you a brief account of some results I have deduced in a systematic examination of these eclipses, making only such a selection therefrom as may possibly possess interest for the general reader. I shall omit any reference to the purely astronomical conclusions to which I have been led, which would be out of place in your columns, and, indeed, would extend this communication beyond reasonable limits. It may, however, be desirable to state that I have employed the last value of the secular acceleration of the moon's mean motion given by Professor Hansen, of Gotha, the author of the latest lunar tables, and have combined other important elements as determined by him with the results of M. Leverrier's tables of the sun. From recent investigations, it appears by no means improbable that we may have to rely wholly upon the ancient eclipses in fixing the true amount of acceleration in the motion of our satellite.

"I shall follow the chronological order in the subjoined remarks upon some of the better known eclipses of history. These form a part only of the phenomena I have rigorously examined upon the same system of calculation.

"1. The Nineveh Eclipse of B.C. 763, June 15.—The discovery of the record of this eclipse on one of the Nineveh tablets in the British Museum was announced by Sir Henry Rawlinson in the *Athenæum* of May 18, 1867, to which I refer for details of its bearing on the sacred and profane history of the period. In the actual state of our knowledge it is the *terminus a quo* for researches on the historical eclipses, and I believe I am correct in saying its value in an astronomical point of view is greater than that attaching to the famous eclipse predicted by Thales to the Ionians, as mentioned by Herodotus. The underlining of the inscription appears to indicate a phenomenon of unusual character or that the eclipse was total in or near Nineveh. Adopting for the position of the city the longitude and latitude deduced by the Astronomer-Royal for the pyramid of Nimrud, I find the calculated southern limit of totality would pass a few miles south of Nineveh, leaving a very large partial eclipse at that city. Very trifling corrections in the lunar elements employed would suffice to bring the total eclipse over it. In this longitude the duration of totality on the central line would be 4m. 20s., the middle of the eclipse at half-past 9 local time.

"2. The Eclipse of B.C. 689, January 11.—The idea that the retrogression of the shadow on 'the dial of Ahaz' during the illness of Hezekiah may have been connected with a solar eclipse has given rise to much discussion, and several writers have endeavoured to point out how the occurrence might thus be explained. Of the eclipse to which attention has been directed the above has perhaps appeared the more probable. It was an annular eclipse, and at Jerusalem the sun would present the form of a luminous ring for 7½ minutes, the middle at 10h. 18m. In Babylon it would have the same appearance for seven minutes. It seems hardly probable that the eclipse could have occurred much latter in the day, though more than one author has considered the circumstance essential for the explanation of the retrograde motion of the shadow on the ancient form of sun-dial by an eclipse. I must leave the reader to judge how far the expression "wonder done in the land" may relate to such a phenomenon, which is, of course, a very rare one in a particular locality.

"3. The Eclipse of Thales, B.C. 585, May 28.—This eclipse, which, as Herodotus informs us, terminated the six years' war between the Medes and Lydians under Cyaxares and Alyattes, when during a battle, 'day was suddenly turned into night,' has greatly exercised the chronologist and the astronomer, and although, misled by imperfect tables of the lunar motions, they have fixed upon other eclipses from time to time, it has been known for some years past that the date distinctly assigned by Pliny (the fourth year of the 48th Olympiad) is the correct one. My new calculation throws the shadow precisely over the tract of country where with the greatest probability it has been supposed the contending armies were situated, and in addition it indicates a circumstance which I believe has not resulted from any previous calculation, and which may not be without its chronological import—viz., that the eclipse was total in Nineveh for between three and four minutes shortly before sunset. The date of the final destruction of Nineveh is closely connected with the eclipse of Thales.

"4. The Eclipse of Xerxes, B.C. 473, February 17.—Much difficulty has been experienced by chronologists with an eclipse which occurred,

according to Herodotus, in the early spring, when Xerxes was setting out from Sardis on his expedition against Greece. It is certain that there was no such phenomenon in the year B.C. 480, to which this event is usually referred, and in examining the eclipses about this period, I found only one that can apply. There is no doubt that the sun was very largely eclipsed at Sardis on the morning of February 17th, B.C. 478. A direct calculation for this place shows that more than 94-100ths of the sun's diameter would be covered, the greatest phase ten minutes after 11, local time. The eclipse was annular, and Sardis appears to have been just outside the annulus. One other eclipse only was visible in eastern Europe about this year, it occurred B.C. 479, October 2, and has been considered to be the one which occurred at the time Cleombrotus consulted the oracles at Sparta. Its magnitude there is found to have been about 6-10ths, the greatest eclipse at 0h. 50min. If the eclipse of B.C. 478 be truly the one recorded by the historian, the date of the battle of Salamis will require to be brought down two years.

"5. The Eclipse of Agathocles, B.C. 310, August 15 (Diodorus, Justin). On the morning after the fleet of Agathocles sailed from Syracuse for Africa, the historians tell us the sun was eclipsed to such a degree (*tantum fit solis deliquium*) that the stars appeared everywhere as at night. Though Agathocles could hardly have been more than 100 miles from Syracuse, it is uncertain in which direction he had sailed, or whether he was rounding Sicily on the north or south side, and this circumstance detracts from the scientific value of the record. My calculation throws a central line near the African coast, so that the fleet, if sailing southwards, would be near the northern limit of totality.

"6. The Eclipse on the Passage of the Rubicon by Cæsar (Dion), B.C. 51, March 7.—This would appear to have been a very notable phenomenon on the Rubicon and in Northern Italy generally. The eclipse was annular, and the annular phase continued 6min. 30sec. At Rome there would be a partial eclipse, about three-fourths of the sun's diameter being covered. A line drawn from 9 deg. 24 min. E. and 43 deg. 26 min. N. to 14 deg. 39 min. E. and 46 deg. 15 min. N. will define the course of the central eclipse across Italy, and the ring-formed appearance of the sun would extend to about 1 deg. 35 min. north and south of this line. The Rubicon would be placed about midway between the central line and the southern limit. Near Ariminum the middle of the eclipse occurred at 0h. 50m. By some writers (including the Abbè du Fresnoy, in his valuable 'Tablettes Chronologiques,') the eclipse is dated B.C. 50; the above, however, is the correct year.

"A great eclipse has been referred in the year B.C. 43 or 44, soon after the death of Julius Cæsar, and it is instanced by Baron de Zach and M. Arago as the first annular eclipse upon record. Calculation shows that there could not have been an eclipse, annular or otherwise, visible in Italy in either of these years, nor, indeed, for several years before or after. The phenomenon alluded to, was, no doubt, of a meteorological character, and this would appear from the passage in Suetonius, one of the authors quoted upon the subject.

"7. The Eclipse of Herod (Josephus).—The lunar eclipse, which I take to be the one recorded by the Jewish historian during Herod's last illness, occurred B.C. 1, January 9. On this occasion the moon passed nearly centrally through the earth's shadow, entering it at 11h. 23m. p.m. mean time at Jerusalem, and emerging at 2h. 57m. a.m. on the 10th; the total eclipse continued 1h. 39m. This is the date recognised by Calvisius, and recently supported by Mr. Bosanquet. An eclipse in B.C. 4, on the night between March 12-13, which other chronologists have

supposed to be the one referred to, was partial only, and did not commence till 1 a.m.; little more than half the moon's diameter was immersed in the earth's shadow at greatest phase.

"8. The Eclipse of Phlegon in the 202d Olympiad (Eusebius), A.D. 29, November 24.—Total on a line crossing the Black Sea, rather west of Odessa, to Sinope, thence, near the site of Nineveh, to the Persian Gulf. At Jerusalem a partial eclipse; about 11.10 a.m. eight-tenths of the sun's diameter would be covered; at Heliopolis (Baalbec) also partial—nine-tenths. At a point on the central line near Sinope the totality would continue 1½ minutes. Humboldt mentions that this eclipse had been calculated by Wurm, but I have not met with his results. It is the only solar eclipse that could have been visible in Jerusalem during the period usually fixed for the ministry of Christ.

"The moon was eclipsed on the generally received date of the Crucifixion, A.D. 33, April 3. I find she had emerged from the earth's dark shadow a quarter of an hour before she rose at Jerusalem (6 36 p.m.), but the penumbra continued upon her disc for an hour afterwards.

"9. The Eclipse of 113, May 31.—Kepler, after endeavouring to ascertain the date of a total eclipse mentioned by Plutarch as having 'recently occurred about noon,' when the darkness was like that of night, and stars were seen in all directions, states he had found none which accorded better with the description than the above. On submitting it to calculation on the modern elements, the central line appears to have passed too far north—over central Germany. I have not succeeded in discovering the date of this eclipse, though I have accurately examined several at the close of the first and beginning of the second century.

"10. The Eclipse of 418, July 19.—Very large at Constantinople, according to Philostorgius, who relates that at the eighth hour of the day the sun was so far eclipsed that the stars appeared, and a comet which had not been previously perceived became visible during the obscurity, and was watched for more than four months afterwards. According to my calculation the central line passed somewhat to the south of Constantinople, where ninety-five hundredths of the sun's diameter would be covered. At a very short distance below that point the eclipse would be total. This is the second occasion upon which the discovery of a comet during a total, or nearly total, eclipse of the sun is recorded in history.

"11. The Eclipse of 671, December 7, on the attempted removal of the pulpit of Mahomet from Medina.—Professor Ockley, in his "History of the Saracens," mentions on the authority of several Arabian writers a a large solar eclipse which occurred about the 52nd year of the Hegira. The Caliph Moawiyah having formed the intention of removing the Prophet's pulpit from Medina to his residence at Damascus, his people proceeded to do so, 'when immediately, to their great surprise and astonishment, the sun was eclipsed to that degree that the stars appeared.' Baron de Zach refers the eclipse to 674, October 4, but in this he is certainly mistaken—I believe through a wrong assumption as regards the moon's latitude. The correct date would appear to be 671, December 7. The eclipse of this day was annular on the central line. At Medina the greatest phase occurred at 10h. 43m., when 85-000ths of the sun's diameter would be obscured. In the clear skies of that part of the world such a degree of eclipse might be sufficient to bring out the brighter planets or stars. No larger eclipse, visible at Medina, occurred about this epoch.

"12. The Eclipse of 840, May 5.—Among the causes which are said to have brought on the '*maladie de languer*' that terminated the life of

Louis de Debonnaire was 'the fright which a total eclipse of the sun had occasioned him.' It is related that the King was taken ill at Worms, and having been removed to Ingelheim, near Mayence; he died there on the 20th of June. I find the northern limit of totality in this eclipse passed about 100 miles south of Worms, and on the central line in this longitude the total eclipse continued 5m 25s., an unusually long interval for the latitude of central Europe. The middle occurred at 1.15 p.m., with the sun at an altitude of 57 deg. The phenomenon under such circumstances must have been a very imposing one, and well calculated in those days to inspire alarm.

"I have already described in your columns the track of the total eclipse of 1140, March 20 (William of Malmesbury) across this country, and merely refer to it now to add, that if any one of your readers is aware of its having been recorded as total in London, he might be doing an astronomical service by making the fact generally known.

"13. The Eclipse of 1133, August 2 (Willliam of Malmesbury), a great solar eclipse, considered as foreboding evil to Henry I. of England.—The central line traversed Scotland from Ross to Forfar, and the eclipse was, of course, large in every part of the country. It would be total in Northumberland. In the centre of Forfarshire totality continued 4m. 20s. Berwick-upon-Tweed was about 20 miles within the south limit.

"During the existence of the kingdom of Jerusalem there is mention of an eclipse which would appear to have been total in the city or its immediate neighbourhood, and has been variously dated from the election of Godfrey of Bouillon in 1097. I am inclined to think it must be to the eclipse of August, 1133, that the record applies, though previous or subsequent events may have been mixed up with it by the historian. Continuing the calculation of the track of total eclipse after leaving this island, I find it would enter Palestine near Jaffa, and pass over Jerusalem and Hebron, where the sun would be hidden 4¼ minutes about 3 p.m., and from Nablous on the north to Ascalon on the south the country would be in darkness for nearly the same interval. The magnitude of the eclipse of 1187, September 4, was rather more than 9-10ths at Jerusalem, the central line passing between eight and nine degrees to the north; in the eclipse of 1191, June 23, the magnitude was about 7-10ths.

"14. The Eclipse of 1433, June 7, long remembered in Scotland as 'the black hour.'—It was a remarkable eclipse, the moon being nearly in perigee and the sun not far from apogee. The central line traversed the country in a south-easterly direction, from Ross to Forfar, passing near Inverness and Dundee. Maclaurin mentions that in his time a manuscript account of this eclipse was preserved in the University of Edinburgh, wherein the darkness is said to have come on about 3 p.m., and to have been very profound. By direction calculation for Edinburgh I find the total eclipse commenced at 3h. 3m. and continued 3m 41s. At Inverness totality continued 4m. 32s. The after-course of this eclipse was north of Frankfort on the Main and Munich, over the Dardanelles, south of Aleppo, and thence nearly parallel to the course of the Euphrates to the north-east border of Arabia. The totality was observed in the Turkish dominions according to Calvisius.

"15. The Eclipse of 1598, February 25.—Maclaurin says the memory of this eclipse was preserved among the people of Scotland, and 'that day they termed Black Saturday.' He adds:—'There is a tradition that some persons in the north lost their way in the time of this eclipse, and perished in the snow'—a statement the probability of which our experience of recent phenomena by no means tends to support. The central

eclipse may be described as having passed about five miles south of Stranraer to the Bass Rock, a little south of Edinburgh, or, more precisely over Dalkeith. Totality came on at Edinburgh at 10h. 15m., and continued 1m. 30s. The duration was the same at Douglas, Isle Man. From the rapid motion of the moon in declination the course of the central line was a quickly-ascending one, in latitude on the earth's surface, the total eclipse passing off within the Arctic circle. Kepler must refer to another eclipse which was observed by Jessenius at Torgau on the Elbe, though he gives the above date

"16. The Eclipse of 1652, April 8, to which reference is also made by Maclaurin as 'still famous among the populace of Scotland, and known among them by the appellation of Mirk Monday.' The central line passed over the south-east of Ireland, near Wexford and Wicklow, arrived on the shores of Scotland near Burrow Head, Wigtonshire, and running within a few miles from Edinburgh, Montrose, and Aberdeen, left the island at Peterhead. Greenock and Elgin would be situate near the north limit, and the Cheviots and Berwick upon the south limit of totality. The eclipse was observed at Carrickfergus, Ireland, by Dr. Wyberd. I find by direct calculation for this place that it was only just within the north limit of totality, which would commence at 10h. 8m. 30s., and continue 44s. This short duration may partly explain a curious remark of Dr. Wyberd, that when the sun was reduced to 'a very slender crescent of light, the moon all at once threw herself within the margin of the solar disc with such agility that she seemed to revolve like an upper millstone, affording a pleasant spectacle of rotatory motion.' Wyberd's further description clearly applies to the corona.

"I believe it has been generally supposed that the last total eclipse of the sun visible in England was that of 1715, May 3, so wel recorded by Hally in the 'Philosophical Transactions' of the Royal Society, and I was under this impression myself until, on calculating the elements of the eclipse of 1724 (May 22), observed at Paris, and by the French King at the Trianon, I discovered that before reaching France the belt of totality must have traversed the south-west of England, and it now appears that the totality did not pass by us unrecorded.

"I am indebted to the Astronomer Royal for referring me to an account by Dr. Stukeley, who observed the eclipse from Salisbury Plain. The duration of totality in that locality would be rather less than three minutes. The eclipse of 1724 is therefore the last that has been total in England, and as I have shown in a previous communication, there will be no other till August 11, 1999, and that will be confined to the south-west corner of the country."

To this the following reply appeared:

To the Editor of the *Times.*

Sir,—I should be glad to offer a few remarks on the very interesting communication of Mr. Hind on historical eclipses. I will endeavour to be as brief as the importance of the subject will permit.

In regard to events in history it is desirable to lay down some rule as to the respective provinces of historical testimony and science.

In regard to the time, the magnitude, and other circumstances of an eclipse, we must bow at once to the authority of men like Sir G. Airy and Mr. Hind. Dr. Hincks, indeed, asserts that in the mathematical

expression on which their calculations are founded there are some coefficients which admit of variation when the calculation relates to very distant epochs. But I do not presume to attribute any weight to this, as I am unable to test it. I accept the determination of all these points as calculated by these great astronomers. But there I feel their absolute authority ends. Their testimony is only one part of the case, and the other evidence must be examined.

In two cases I entirely demur to the conclusions drawn from the evidence of eclipses by Mr. Hind in his valuable Memoir.

These are (1) the eclipse of Thales, and (2) the eclipse of Xerxes.

1. The eclipse of Thales, May 28, B.C. 585. Both Sir G. Airy and Mr. Hind consider that this was the eclipse which terminated the war between the Medes and the Lydians. Now, Herodotus, who was born more than a century after this eclipse, is the original authority on which the connexion between this eclipse and Thales and the Lydo-Median war has descended to us. But Herodotus declares it to have occurred in the reign of Cyaxares, who died in B.C. 594, as all historical evidence and the authority of Herodotus himself leads us to believe. The question is largely discussed in *Clinton, F.H.*, vol. 1, p. 418. It may be added, however, that some ancient authorities state that it was in the reign of Astyages, the successor of Cyaxares. But, as Clinton shows, many circumstances concur in leading to the belief that this war terminated before B.C. 600. Able astronomers have fixed on two eclipses—B.C. 610 and B.C. 603, as the eclipse of the battle. Thales is said to have predicted the eclipse which closed the war. Some authorities would bring down the reign of Cyaxares beyond B.C. 585, by which they subvert all the most careful chronology, which is established on very strong evidence. But this is surely unphilosophical. A tradition first reported 120 years at least after the event connects the close of the war and the prediction of the eclipse by Thales with each other. Another later tradition connects the prediction of the eclipse with the eclipse of B.C. 585. The authority of Herodotus is explicit against a war between the Lydians and the Medes at so late a period. Therefore, if we connect the battle and the eclipse of B.C. 585 he entirely contradicts himself. Does not this teach us to examine the evidence on which these events are connected? A tradition passing through 120 years and many months, might easily be confused. Suppose the eclipse of B.C. 603 to have been the battle eclipse, and Thales, by the *Saros*,* to have predicted that of B.C. 585, is it not easy to see how this tradition might have arisen, and the two eclipses become confused? The answer usually given to this suggestion is, that only a total eclipse could produce so great a moral effect, and that Herodotus says "day suddenly became night." He says the same thing of another eclipse which was not total, except the word "suddenly." But there he adds, "the sun left the heavens." Surely there is not evidence enough in this tradition to overturn all established chronology, which is contradicted also by the author who reports it. We know little what the moral effect of a large eclipse might be in those ages.

2. The eclipse of Xerxes. Mr. Hind appears disposed to bring down the date of the battle of Salamis two years, on the evidence of an eclipse seen by Xerxes on his way from Sardis to Greece. There was no eclipse in B.C. 480, but a large one in B.C. 478. But there was also an eclipse in B.C. 482, and if we suppose him on his way from Susa to Sardis this might be the eclipse. His Magi predicted from it his conquest of Greece.

* *Saros*. This is the period of 223 lunations, for 18 years, 10 days, and 8 hours, by which the Babylonians calculated eclipses by their observations.

So that it could not be after his defeat; and the date of the battle of Salamis is too well known to admit of a reduction of two years. We must, therefore, believe that there is some error in the tradition, if we deny that any eclipse but that of B.C. 478 is to be accepted. It will be seen at once that a contemporary report of an eclipse stands on a very different footing from a tradition reported half a century afterwards.

These considerations are very important in regard to the evidence on which we accept accounts of historical events. Eclipses are very useful correctives when we can depend on their connexion with the events with which they are associated by tradition; but when that tradition is of a doubtful kind they must be subjected to the laws of historical evidence, as well as of scientific accuracy.

I remain, Sir, yours, &c., IGNOTUS.

THE METEOR COMET OF AUGUST.

To the Editor of the *Times*.

Sir,—The remarkable discovery made in 1866 by Signor Schiaparelli, director of the Observatory of Milan, that the August meteors move round the sun in an orbit almost identical with that of a large comet which became visible in July, 1862, has given occasion to several sensational announcements founded upon the close approach of the comet to the earth's orbit, at the point where it passes from the north to the south side of the plane of the ecliptic, at which point the earth arrives about the 10th of August, when for many years past (indeed, since Professor Quetelet's announcement of the periodicity to the Belgian Academy of Sciences in 1836) we have been accustomed to look for an unusual display of shooting stars. A few remarks may not be inopportune at the present time.

The second comet of 1862, as it is usnally termed, was first detected by Mr. Tuttle, now of the United States Navy, at the Observatory of Harvard College, Massachusetts, on the 18th of July, in the constellation Camelopardus, and was subsequently independently discovered at Florence, Rome, and Copenhagen. It presented a very conspicuous appearance in Corona Borealis and vicinity in the latter part of August, exhibiting a tail variously estimated, according to clearness of atmosphere, at from 25° to 30° in length. It was last seen in Europe, at Athens, on the 26th of September; but was followed at the Royal Observatory, Cape of Good Hope, till the 25th of October, when it was lost to view in the southern constellation Ara. A few weeks after the discovery of the comet it became evident that its path deviated sensibly from a parobola, the curve in which, for facility of computation, it is usual to suppose these bodies to be moving, and many comets show no appreciable deviation from this curve, even during a long period of visibility. Various elliptic orbits were assigned, but the last and most complete determination of the elements is by Professor Oppolzer, of Vienna, one of the most accomplished calculators of the present day. He finds the period of revolution to be 121½ years, and it is certain that this period must be very close upon the true one.

Now, it follows from Professor Oppolzer's definitive calculation of the elements, that in 1862 the orbit of the comet intersected the plane of the earth's annual path at a point which was situate only 430,000 miles from our track—a circumstance sufficient, under certain conditions, to have brought about a collision (so to call it) between the two bodies. In order, however, that this should be possible, the comet must have arrived

at its least distance from the sun soon after midnight on the 21st of July, and in this case it would have encountered the earth about noon on August 10th. As it happened, the point of least distance from the sun was not attained till the 23rd of August, and when the comet was upon our track we were far in advance upon our annual journey, and so escaped a meeting which astronomers would probably have regarded with more interest than alarm. It is, of course, possible that at some past time a much closer approach may have occurred, but after carefully examining the various descriptions of comets, European and Chinese, which have descended to us, I have failed to discover any one that can be certainly identified with that of 1862.

If we take the orbit of the comet to represent that of the meteors, we have the following numbers, which will serve for the delineation of their track round the sun.

	Units.
Semi-axis major	24·531
Semi-axis minor	6·805
Semi-parameter	1·888
Perihelion distance	0·963
Aphelion distance	48·100

The above are expressed in units of the earth's mean distance. At least distance from the sun the meteors travel with a velocity of 1,560 miles per minute, and at their greater distance, about 31 miles in the same interval.

From the regular appearance of shooting stars in considerable numbers about August 10th, it would follow that they must be distributed through a large portion of their orbit, though the comet is visible to us only once in about 120 years. Its next appearance, even allowing for the effects of perturbations, can hardly be expected before the year 1980.

The earth will arrive at the comet's descending node about 11 p.m. on Friday next, the 9th inst., and perhaps we may look for the greatest number of meteors during that night, though our passage through the stream usually extends over several days. The comet itself will be distant from us nearly twenty-three times the distance of the earth from the sun, and could we reach it with our telescopes, it would be found in about Right Ascension 9h. 4min. and 27° south of the celestial equator, consequently, in the southern constellation, Antlia Pneumatica. It is only when the comet arrives at its least distance from the sun, between July and September, that it can be a conspicuous object in the northern hemisphere. If this point be reached in winter, it might very easily pass by unobserved, and to this circumstance is no doubt partly attributable the apparent absence of any previous record of its visits to these parts of space.

The radiant point of the August meteors is in about Right Ascension 3h. 24m. and North Declination 52° for 1872, and, therefore, in the neighbourhood of the star Alpha Persei. The apparent radiation from this constellation has led to the frequent adoption of the term "Perseides" for these transient visitors. It is still desirable to fix this point carefully by observation, as during the last few years a somewhat higher declination has been indicated than formerly.

I am, sir, your obedient servant,

J. R. HIND.

Mr. Bishop's Observatory, Twickenham:
August 7.

Present of Newton's Manuscripts to Cambridge University.—A letter from his Grace the Chancellor of Cambridge University has been received, stating that it is the intenton of Lord Portsmouth to present to the university all Sir Isaac Newton's manuscripts, with the exception of those relating to private affairs, and that his lordship wishes the transfer should be proceeded with at as early a period as possible.

Sun Storm.—All our thunderstorms, eruptions, &c., dwindle into insignificance, when we hear of the gorgeous phenomenon which the Rev. Father Secchi, at Rome, a most enlightened clerical, was allowed to observe on our sun's rim a few days ago. It was one of those rugged erosions of the sun's disc, not perceptible to the naked eye, called mildly "rosy protuberances" by the faculty, which in reality are nothing but huge explosions, darting immense quantities of caloric into the planetary space, and thus determining the abnormal temperatures we have sometimes to suffer under or profit by. The eruption lasted for about two hours in the afternoon; spiral flashes of ignited hydrogen, containing volatilised iron, copper, and other metals, took place in unabated fury. The eruption comprised about ten degrees of the sun's periphery, and rose to the tremendous height of 80,000 miles (ten times the diameter of our conceited globe). It then collapsed, but just before the sunset recommenced with double rage.—*Standard.*

The late Sir J. Herschel.—A few days since a meeting, called by Lieutenant-Colonel Loyd, of Lillesden, was held for the purpose of considering a proposal to erect in the parish church of Hawkhurst, in Kent, a window to the memory of Sir John Herschel. Colonel Loyd has procured a design from Messrs. Clayton and Bell, as well as an estimate of the cost. The subject of the window is to be, the wise men of the east following the guiding star to the place of the Nativity, and the cost will be 160*l*. The appeal has been liberally responded to, and a larger amount than is required for the purchase of the window has been subscribed. The memorial will be completed, it is said, by Christmas.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE TRAPEZIUM IN THE ORION NEBULA.

Sir,—There is little evidence in favour of the view that the 5th and 6th stars are variable. As to either being visible with a 3-inch telescope it is somewhat remarkable that the possessors of large instruments can never see them with so small an aperture, although a reduced aperture must be—from the longer focus—at least as good for this purpose as the full area of a small aperture. Careful observers will have noticed the frequent tendency of the rings on some nights to break up into *quasi comites*, and this is a likely cause for the objective appearance which has led persons to believe 3 inches of aperture have exhibited these minute points.

It would seem almost a physical impossibility that a power of 80 with this aperture would suffice to show the 6th, whose distance from the *brightest* of the trapezium was put by Dawes at 2″8.

Mr. Denning has made a slight miscopy on p. 191 (unless it is the typographer), where he gives $3\frac{1}{4}$ inches as the size mentioned in "Celestial Objects." It should be $3\frac{8}{10}$ inches—a material difference—which showed the 5th.

I have frequently looked at this beautiful object, but could never see the 5th with a less reduced aperture than would be about equal to a 4-inch refractor.

I believe the only certain method of establishing either the fact or the period of variability is to observe with reduced apertures of instruments fully competent to deal with these minute points on fine nights. They are peculiarly sensitive to atmospheric hindrances.

I am, sir, yours truly,
August 6, 1872. T. H. BUFFHAM.

Sir,—Although I am not prepared to express a definite opinion on the allegation that the 5th and 6th stars are variable, I do with some confidence assert that neither were visible in a 3-inch achromatic between 1861 and 1865. I repeatedly examined the object in question during that period with a good 3-inch of Cooke's, and never could obtain a glimpse even of the 5th star, much less of the 6th. If either is now visible in a telescope of that size, especially if the 6th is visible, they must both of them, but especially the 6th, be variable.

From a perusal of the letters of many observers concerning the brightness of different sidereal objects, I have often come to the conclusion that sufficient caution is frequently not exercised by observers in recording on paper what they have seen; that is to say, that atmospheric influences often affect in a most material degree the visibility of particular objects. In other words, that the fact that A at one time saw a thing which B some time afterwards did not see, is in certain cases rather a proof that B looked through an atmosphere less clear than A did, than that the intrinsic brilliancy of the object under consideration had fallen off, as B would have the world believe.

Windyhills Observatory, Your obedient servant,
Bickdy: Aug. 9, 1872. G. F. CHAMBERS.

Sir,—As in the *Astronomical Register* of this month there is a letter of Mr. Denning upon the visibility in small instruments of the 5th and 6th stars of the trapezium of Orion, it may, perhaps, not be without interest to lay before your readers a translation of an extract from a letter relating to those stars, addressed by M. Wilhelm Temple to the Editor of the *Astronomische Nachrichten*, and inserted in No. 1898 of that periodical, which came to hand a day or two since.

M. Tempel, who writes from Milan on the 8th ultimo, says as follows :—

"I do not know whether the whole of the 6 stars of the trapezium in the great nebula of Orion have been made out with a refractor of 4 inches aperture.

"After having for several years endeavoured in vain to get a sight of the 2 smaller stars of the trapezium, I this spring succeeded in doing so with ease, and that altogether by accident.

"While my having done this is a proof of the excellence of my 4-inch instrument by *Steinheil*, the circumstances under which the observations

were made, namely, during the short interval between the end of twilight and the beginning of night, contributed very materially to the result. For earlier in the evening the glare of the twilight prevents the transmission of the more feeble rays, while somewhat later they become overpowered by the brighter stars in the immediate neighbourhood.

"For many evenings in succession I saw without difficulty the stars in question at the period I have mentioned. The 5th star was to be seen with remarkable ease. In *Liapounov's* drawing, Plate 3, its position is not indicated correctly, more so however in Plate 2. The 6th star is somewhat more difficult to make out, inasmuch as it is more minute, and near the brightest star *a* of the trapezium. The power I used was 240.

"On this occasion I moreover noticed, what I never observed before, that the entire trapezium is situated in a delicate but very distinctly visible nebula, which ceases, however, to be distinguishable when the night has grown dark.

"By turning the circumstance above spoken of to account, the companion of Sirius, which many observers have failed to get a sight of, may be perhaps rendered visible in instruments of moderate size."

I am, Sir, your obedient servant,

Lower Norwood. W. G. LETTSOM.

7th August, 1872.

THE NEBULA IN THE PLEIADES.

Sir,—The note on this subject in your last issue is very unsatisfactory, for two reasons,—1st, it contains but a very imperfect statement of previous observations; and, 2nd, the writer totally fails to understand the true meaning of the concluding sentences of my last communication. This renders it necessary to give a fuller statement of the reasons I have had for doubting any change in this curious and interesting object.

1st. The nebula was discovered by Temple, at Venice, October 19th, 1859; he describes it as large, bright, and twinkling in places like a comet; in the next year, 1860, he could just see it in the 6-foot refractor at Marseilles. But it was an easy object to Anwers, of Gottingen, in a comet-finder of 2 feet focus on September 23rd and 24th of this same year, and this when only 16° above the horizon. 1862, August, it was looked for in vain by d'Arrest, of Copenhagen, with an 11-inch achromatic. But on March 26th of this year, Schmidt, of Athens, says, "The great triangular nebula in the Pleiades easily visible, its extension towards the west is, however, much greater than I had previously believed."

In March and September, 1862, it was observed in some of the smaller instruments at Poulkowa; yet the Director, Otto Struve, employing a power of 150 on the achromatic of 14¾ aperture, could only satisfy himself that he saw it by moving the telescope to and fro.

The Rev. T. W. Webb found it readily with a 5½-inch achromatic, 1863, October 6th, but describes it as "very feeble," 1865, September 25th.

2nd. Your correspondent lays particular stress on the fact that the nebula was described as "large and bright" in 1859, while I can now only just see it with a 12¼ speculum. I would call his attention to the observations of Struve, as showing that ten years ago it appears to have been no better seen in the great achromatic at Poulkowa than it is at present in the silvered glass reflector, a similar power being used in both instances.

Your correspondent does not see how the observations of a nebula for 2½ years should make us confident of its condition "many hundreds and

perhaps thousands of years ago" But if he carefully reads my letter, he will fail to find where this is stated, or even implied; of course I had read the previous history of this object long before I ever saw the nebula, and I thought the evidence was certainly not in favour of variation; but I refrained from occupying the space of the *Register* by repeating what might easily have been found elsewhere, until compelled to do so; and it was only when I saw the announcement that the object had been searched for in vain with an 8-inch achromatic, followed by the startling assertion, "there is something peculiar about *all* the brighter stars of this group, which for months past have appeared to me as if surrounded by nebulous lights." Can the nebula have been distributed among them? I felt bound to mention the fact that for 2½ years I had observed the nebula unchanged; but, so far from relying on my own observations, I distinctly say, "here then we have an explanation of many of the supposed changes which this object has been supposed to undergo," referring, of course, to the great differences in the visibility of the nebula in different telescopes, and with various magnifying powers, seconded by other observers and witnessed by myself, and then, bearing all this in mind, I conclude in these words, "and it appears more than ever certain to my mind, bearing in view the extreme tenuity and extent of this object, that we see it now exactly as it has existed for many hundreds and, perhaps, thousands of years;" and I fail to see in your correspondent's letter anything calculated to alter this opinion.

Richmond: I am sir, yours very truly,
August 12, 1872. CHARLES GROVER.

HISTORICAL ECLIPSES.

Sir,—In the *Register* for August, Mr. Denning, in replying to "A Subscriber," states upon the authority of Ferguson, that the solar eclipses of April 6th, 1540, Oct. 3rd, 1633, and July 12th, 1684, were visible as total eclipses in England. They are certainly set down in Ricciolus's catalogue as total, but I see nothing in Brewster's edition of "Ferguson's Astronomy," 1821, to show that in any of these cases the total phase was visible in England.

Again, it appears to be assumed that the dark shadow of the moon in the great eclipse of the 17th June, 1433, passed over England instead of Scotland. A very rough computation enables me to say that the central line of this eclipse did not touch England at all, but that a strip of the northern counties was probably within the southern limit of the total phase.

Did this eclipse occur on a Saturday, as was stated by "A Subscriber," or was Wednesday the day?

Will some one of your readers, possessed of the requisite energy, be so good as to compute from the Tables of Leverrier and Hansen, the elements of this eclipse and publish them in the *Register*; or, if such elements already exist to state where they are to be found.

I am, sir, your obedient servant,
Norwich: August, 1872. J. MAGUIRE.

FUTURE SOLAR ECLIPSES.

Mention is often made in astronomical works about solar eclipses in past ages, but not much about those to come. This has been done with regard to transits of Venus. Delambre has given a list of them for a period of twenty centuries. The following list of future solar eclipses I have

computed from some expeditions' tables. Having first tried a great number of known solar eclipses by them, I never found them more than a few minutes out in the time of the greatest obscuration (that of May, 1873, being the furthest out), and the size of the eclipse has always been correct. For instance, they gave the celebrated eclipse of 1140 as not total at London, though it evidently was total in England (see *Astronomical Register*, August, 1871, page 178), an uncovered crescent being left on the sun's south limb, showing the shadow must have gone N. of London, thus agreeing with Mr. Hind's result. As lists of eclipses to the end of this century are given in two or three works, I have commenced with the next. The next great eclipse takes place forty years hence, in 1912. The moon's semi-diameter does not quite equal the sun's, but at London only a narrow crescent on the upper part of the sun's disc is left uncovered soon after midday. One follows in 1921, apparently annular in the northern parts of the kingdom, and is the next central eclipse we shall have in the British Isles. As to the eclipses of the twenty-first century, those of 2026, August 12, and 2081, September 3, seem total in France, that of 2093, July 23, annular in England. On September 23, 2090, there occurs an eclipse which would be total at London but is close upon sunset. I believe this country will see the following total solar eclipses in future ages: (1) that of 1999, described fully by Mr. Hind, (2) that of 2135, October 7, (3) that of 2151, June 14, which appears to include London, totality taking place there about 6.30 p.m., but the central line probably goes N. of the metropolis, (4) one on April 14, 2200, of very short duration.

Column (1) shows date, (2) approximate hour of greatest obscuration, (3) digits or twelfth parts of the sun's diameter obscured, M. signifies morning, A. afternoon.

(1)	(2) h.	(3) °
1905, August 30	1 A.	10
1908, June 28	5¾ A.	2
1912, April 17	0½ A.	11
1914, August 21	noon	8
1916, Feb. 3	sets eclipsed.	
1919, Nov. 22	sets eclipsed.	
1920, Nov. 10	sets eclipsed.	
1921, April 8	9 M.	10
1922, March 28	2¼ A.	2
1925, Jan. 24	3¾ A.	7
1927, June 29	5¼ M.	11
1928, Nov. 12	8½ M.	2
1929, Nov. 1	11¾ M.	1
1936, June 19	4¼ M.	6
1939, April 19	6¼ A.	4
1942, Sept. 10	4¼ A.	4
1945, July 9	2 A.	7
1949, April 28	7½ M.	4
1952, Feb. 24	9 M.	1
1954, June 30	0½ A.	10
1959, October 2	0¼ A.	4
1961, Feb. 15	7½ M.	11
1966, May 20	9½ M.	6
1968, Sept. 22	10¼ M.	4
1971, Feb. 25	9½ M.	7
1972, July 10	8 A.	6
1973, Dec. 24	sets before the middle.	
1975, May 11	6½ M.	6
1976, April 29	10¼ M.	5
1982, Dec. 15	8¼ M.	5
1984, May 30	6¼ A.	5
1994, May 10	6¾ A.	6
1996, October 12	2½ A.	7
1999, August 11	10 M.	11

S. J. JOHNSON, F.R.A.S.

Upton Helions Rectory,
Crediton: July 27.

Errata. In an article on ancient eclipses in the *Register* for August, 1871, there should be the following corrections: In the eclipse of 733, for ¼ *past* 7, read, ¼ *past* 8; in eclipse of 1133, instead of *further south the eclipse would be total*, read, *further north the eclipse would be total.*

CONNECTION OF METEOROLOGY AND ASTRONOMY.

STORMS.

Sir,—There may be some importance in the fact that some years are more than usually stormy, whilst others are comparatively calm ; and it is even possible that some connection may exist between astronomical phenomena and storm periods. From the table which I subjoin, it will be seen that we had a stormy period at the sun-spot maxima of 1860, and now again we are experiencing a large number of storms.

TABLE.

No. of occasions in which the wind moved at the rate of 30 miles per hour, or upwards.

A.D.		No. of Occasions.		A.D.		No. of occasions.	
1852	...	0		1863	...	38	
1853	..	0		1864	...	26	
1854	...	4		1865	...	58	
1855	...	38		1866	...	23	
1856	...	43		1867	...	21	
1857	...	43		1868	...	20	
1858	...	19		1869	...	17	
1659	...	81	storm	1870	...	13	
1860	...	68	period.	1871	...	63	storm
1861	...	73		1872, to July 27th,		30	period.
1862	...	27					

If this stormy condition of the atmosphere extends over the whole hemisphere, or globe, the fact that disasters at sea have been more frequent of late than in 1869, finds an explanation, and if patient investigation should enable us to know when a storm period approaches, something of a practical value would be gained.

The annual amount of rain in inches (discarding fractions), as measured at Toronto, is as follows :—

TORONTO RAINFALL.

Year.	Toronto Rainfall.		Year.	Toronto Rainfall.	
1840	26		1857	33	
1841	37		1858	28	
1842	42	*	1859	33	Wet.
1843	43	Wet.	1860	23	Dry.
1844	19	Dry.	1861	26	
1845	22	*	1862	25	
1846	32		1863	26	
1847	33	Wet.	1864	29	
1848	22	Dry.	1865	26	
1849	32		1866	34	Wet.
1850	28		1867	19	Dry.
1851	26		1868	26	
1852	31		1809	31	
1853	23		1870	33	Wet.
1854	27		1871	23	Dry.
1855	31	Wet.	1872	27	
1856	21	Dry.			

It will be seen that the years of sun-spot max. and min. have been dry, and the preceding years wet, but we defer remarks for a future occasion.

Truly yours,

Toronto: July 25. A. ELVINS.

JEREMIAH HORROCKS.—Enquiry is made in the *Athenæum* as to the parentage of Jeremiah Horrocks, the astronomer, born 1619, at Foxteth, near Liverpool.

COMET I., 1871.

Prof. A. Hall, of Washington, has computed new elements of this comet, based on the whole series of published observations. The elements are as follows:—

Perihelion passage 1871, June 10.62. Berlin M.T.

		°	′
Longitude of perihelion	=	141	37
Longitude of ascend. node ...	=	279	16
Inclination	=	87	35
Log. perihelion distance	=	9·817018	

Motion—direct.

SUN.

Greenwich, Noon. 1872.		Heliographical western longitude of the centre of the sun's disc.			Heliographical latitude		Angle of position of the sun's axis.
		°			°		°
Sept. 1	...	245·54	+244 δ ξ	...	+7·22	...	21·50
2	...	258·76		...	7·23	...	31·75
3	...	271·98		...	7·24	...	21·99
4	...	285·20		...	7·25	...	22·23
5	...	298·42		...	7·25	...	22·46
6	...	311·64		...	7·25	...	22·68
7	...	324·86		...	7·25	...	22·90
8	...	338·08	+251 ,,	...	+7·25	...	23·11
9	...	351·30		...	7·24	...	23·32
10	...	4·52		...	7·23	...	23·52
11	...	17·74		...	7·22	...	23·71
12	...	30·96		...	7·21	...	23·90
13	...	44·18		...	7·19	...	24·08
14	...	57·39		...	7·18	...	24·26
15	...	70·61	+258 ,,	...	+7·16	...	24·43
16	...	83·83		...	7·14	...	24·60
17	...	97·05		...	7·12	...	24·75
18	...	110·26		...	7·09	...	24·90
19	...	123·48		...	7·07	...	25·04
20	...	136·69		...	7·04	...	25·18
21	...	149·91		...	7·01	...	25·31

22	...	163·12	+265 ,,	...	+6·97	...	25·44
23	...	176·33		...	—6·94	...	25·56
24	...	189·55		...	6·90	...	25·67
25	...	202·76		...	6·86	...	25·77
26	...	215·97		...	6·82	...	25·87
27	...	229·18		...	6·78	...	25·96
28	...	242·39		...	6·73	...	26·05
—							
29	...	255·60	+272 δ ξ	...	6·69	...	26·12
30	...	268·81		...	6·64	...	26·19

Assumed daily rate of rotation, 14°·20 + $\delta\lambda$.

MOON.

LIBRATION. SUN'S PLACE.
Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* | *Sun's* centre in the zenith.
Greenwich, Midnight.

TERMINATOR.
Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.

1872.	colong.	lat.	colong.	lat.	60° N.	0°	60° S.
	°	°	°	°	°	°	°
						SUNRISE.	
Sept. 9	95·55	+0·36	358·24	+1·51	90·9	88·2	85·6
10	94·99	1·92	10·43	1·51	103·0	100·4	97·8
11	94·12	3·39	22·63	1·51	115·2	112·6	110·0
12	92·93	4·69	34·82	1·50	127·4	124·8	122·2
13	91·44	5·70	47·00	1·50	139·6	137·0	134·4
14	89·77	6·34	59·17	1·49	151·7	149·2	146·6
—							
15	88·02	+6·56	71·54	+1·49	163·9	161·3	158·8
						SUNSET.	
16	86·36	6·34	83·51	1·48			
17	84·95	5·70	95·68	1·47	3·2	5·7	8·2
18	83·90	4·73	107·85	1·46	15·3	17·8	20·4
19	83·29	3·50	120·01	1·44	27·5	30·0	32·5
20	83·15	2·11	132·19	1·43	39·7	42·2	44·7
21	83·44	+0·65	144·37	1·42	51·9	54·4	56·8
—							
22	84·12	—0·80	156·55	+1·40	64·1	66·6	69·0
23	85·10	2·17	168·74	1·39	76·3	78·7	81·2
24	86·29	3·43	180·93	1·38	88·5	90·9	93·3
25	87·59	4·52	193·13	1·36	100·8	103·1	105·5
26	88·93	5·42	205·34	1·35	113·0	115·3	117·7
27	90·22	6·08	217·54	1·33	125·2	127·5	129·9
28	91·42	6·48	229·76	1·32	137·5	139·8	142·1
—							
29	92·44	—6·60	241·97	+1·30	149·7	152·0	154·3

Colong. = 90° —λ.

DEATH OF MR. DELAUNAY.—August 12th, 1872. News was received by Sir G. B. Airy of the death of M. Delaunay, Director of the Paris Observatory. Born 1816.

ASTRONOMICAL OCCURRENCES FOR SEPT., 1872.

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
Sun	1		Sidereal Time at Mean Noon, 10h. 43m. 49·35s.	3rd Ec. D.	16 27 5	Saturn. 8 19·3
Mon	2	12 53 19 53	● New Moon Conjunction of Moon and Mercury 8° 57′ S.			8 15·3
Tues	3	 14 39	Sun's Meridian Passage, 55m. 5·37s. before Mean Noon Conjunction of Moon and Venus, 3° 49′ S.			8 11·2
Wed	4			2nd Oc. R.	15 40	8 7·2
Thur	5					8 3·2
Fri	6					7 59·2
Sat	7			1st Sh. I. 1st Tr. I.	15 51 16 26	7 55·1
Sun	8			1st Oc. R.	16 8	Moon. — 4 8·7
Mon	9					5 1·0
Tues	10	2 3	☽ Moon's First Quarter			5 57·4
Wed	11	22 42	Conjunction of Moon and Saturn 3° 13′ N.			6 57·7
Thur	12			3rd Tr. E.	16 30	7 59·9
Fri	13		Saturn's Ring : Major Axis=39″·17 Minor Axis=16″·43			9 2·0
Sat	14	8 27 9 21	Occultation of B.A.C. 7550 (6) Reappearance of ditto			10 1·7
Sun	15	 11 29 12 33 12 46 13 50	Illuminated portion of disc of Venus = 0·959 Illuminated portion of disc of Mars = 0·967 Occultation of τ^1 Aquarii (6) Reappearance of ditto Occultation of τ^2 Aquarii (4) Reappearance of ditto	1st Ec. D.	15 7 49	10 58·1
Mon	16	17 4	○ Full Moon	1st Sh. E. 1st Tr. E.	14 34 15 16	11 51·2

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Tues	17		Sidereal Time at Mean Noon, 11h. 46m. 54·20s.			Moon. 12 41·6
Wed	18		Sun's Meridian Passage, 6m. 5·45s. before Mean Noon	2nd Ec. D.	16 51 27	Saturn. — 7 11·5
Thur	19	13 33 14 46	Occultation of B.A.C. 728 (6½) Reappearance of ditto	3rd Tr. I.	17 11	7 7·6
Fri	20			2nd Sh. E. 2nd Tr. E.	14 53 16 26	7 3·7
Sat	21	4 36	Conjunction of Jupiter and Mars, 0° 36′ N.			αAquilæ — 7 40·6
Sun	22			1st Ec. D.	17 1 31	7 36·7
Mon	23	18 23 11 45 12 45	Conjunction of Mercury and σ Leonis 0° 5′ S. Occultation of 132 Tauri (5½) Reappearance of ditto	1st Sh. I. 1st Tr. I. 4th Tr. I. 1st Sh. E. 1st Tr. E.	14 7 14 56 15 34 16 27 17 1 6	7 32·8
Tues	24	1 21 12 27 13 27	☾ Moon's Last Quarter Occultation of ε Geminorum (3½) Reappearance of ditto	1st Oc. R.	14 37	7 28·8
Wed	25					7 24·9
Thur	26	18 43	Conjunction of Moon and Uranus 3° 53′ S.			7 20·9
Fri	27			2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	14 32 16 16 17 28	7 17·0
Sat	28	5 38 11 54	Conjunction of Moon and Jupiter, 4° 29′ S. Conjunction of Moon and Mars, 3° 56′ S.			7 13·1
Sun	29					7 9·2
Mon	30			3rd Oc. R. 1st Sh. I. 1st Tr. I.	15 36 16 1 16 55	7 5·2
OCT. Tues	1	6 50	Conjunction of Moon and Mercury, 3° S.	1st Oc. R.	16 36	7 1·3
Wed	2			1st Tr. E.	13 45	6 59·4

THE PLANETS FOR SEPTEMBER.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m
Mercury ...	1st	10 23 36	+ 6 28½	10″·2	23 35·9
	15th	10 32 12	+10 0	7″·0	22 49·4
Venus ...	1st	11 33 54	+ 4 16	10″·0	0 49·9
	15th	12 37 4	− 2 53	10″·2	0 57·9
Saturn ...	1st	19 4 29	−22 29	16″·0	8 19·3
	15th	19 3 33	−22 32	15″·6	7 23·3
Neptune ...	1st	1 39 5	+ 8 25	2″·0	14 5·28
	17th	1 37 52	+ 8 17½	2″·0	13 48·7

Mercury rises before the sun throughout the month, and may be well observed. In the middle of the month it rises at one hour and a half before the sun, the interval decreasing to an hour.

Venus is very badly situated for observation.

Saturn may be fairly observed throughout the month, till near midnight.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN SEPTEMBER, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

On p. 179 of the July number of the present volume the value of supplement ☾ — ☉ = on June 20, 1871, is quoted at 148° 10′·3; and on p. 198 of vol. ix. the value of supplement ☾ — ☉ is given as 147° 16′·7 on August 18, 1871; and as 22° 3′·3 on August 31, 1871. On September 5, 1872, supplement ☾ — ☉ = 146° 0′·8; and on the 18th—23° 55′·5. The lists of June and August, 1871, vol. ix. pp. 149 and 198, are consequently available for the selection of objects for observation in September, 1872.

Ninth Zone of objects from North to South, 35° *to* 40° *W. long.*

Arnold, Gartner, Hercules, Römer,* Pyrenees, Capella, Neander,* Vlacq,* Nearchus.*

The objects in this zone, which extends 5° further eastward than the eighth, may be looked for about the 5th day of the Moon's age, September 8. Those marked (*) have not been mentioned in the monthly lists. The following may also be added as not having been inserted in those lists:—Legendre, in zone 2, p. 46 of the present volume; Rheita, in zone 7, p. 175; Rosenberger, in zone 8, p. 199.

Season. Summer in the northern hemisphere. The solstice occurs on the 1st.

May I be permitted to offer a remark on the choice of a spot on the Moon's surface, as a fundamental mark in Selenographical investigations?

Perhaps the author of the valuable contributions of the Earth's and Sun's places in the lunar heavens, as regards the Zenith and the position of the terminator, will kindly furnish the express object for which a fundamental mark of reference is desirable? There is certainly much to be accomplished in advancing our knowledge of Selenography, but up to the present moment nothing of any extent appears to have been undertaken according to a well-devised system. There is scarcely anything of greater importance than an increase of *points of the first order*, but nothing has been effected in this department of Selenography since the completion of Mädler's great work; and in extending it a point of reference is not necessary, as each point of the first order is determined independently of every other. A point of reference as to size or magnitude is very important, and the crater *Dionysius* has been chosen for this purpose; a quantity of comparative measures have already been made, now some years since, but they await the means and leisure for publication. Another object for which points of reference in different parts of the Moon's surface are very desirable is that of *relative brightness.* Of such comparisons I have a somewhat large number, also awaiting publication, and ranging between the brightness of the central mountains of Aristarchus and the darkness of the ordinary shadow. The relative brightness of Mosting A has not, I believe, received much attention; B and M record it as 9°.

I may also take this opportunity of suggesting the desirability (for the benefit of the mathematical readers of the *Register*) of the publication of the formulæ by which the positions of the terminator, and of the earth and sun above-mentioned, and also the Heliographical latitude and longitude of the centre of the Sun's disk with the angle of position of the Sun's axis are computed. The reader will find in the Report of the Thirty-sixth Meeting of the British Association for the Advancement of Science, pp. 220 to 238, a list of the points of the first order, with an investigation of the method of determining them, accompanied with the necessary formulæ and an example worked out in full, I need scarcely add that a similar publication of the formulæ for the Moon's terminator, etc.. would be very acceptable.

Errata in article on p. 199, line 7, *August* 13 read *August* 18. Insert — between = and 1° to read = — 1.° 50′·4. Line 10, for *Sautbech* read *Santbech.*

REVIEW.

Scripture and Science not at Variance. By Archdeacon Pratt. Sixth edition. 1871. Hatchards.

The last and much enlarged edition of an excellent work. The mathematical writings of the late lamented author are well known. This volume is remarkable for the calm, dispassionate, argumentative, and convincing treatment of a most important subject.

Errata.—P. 183, line 24 from bottom, for *divisional* read *diurnal;* p. 183, line 6 from bottom, for *discovered about it,* read *discoursed about;* p. 184, line 7 from bottom, for *provision* read *prevision;* p. 186, line 14 and line 19 from top, for *Troerster* read *Foerster.*

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Sept., 1872.
Elliott, R.

To Oct., 1872.
Lewis, Rev. H. K.

To Dec., 1872.
Allen. E. G.
Blacklock, Dr. A. W.
Dobie, Dr. W. M.
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Herschel. Captain
Sargent, Rev. J. P.

To March, 1873.
Herschel, Professor.

To June, 1873.
Green, Jos.

TO CORRESPONDENTS.

NOTICE.—It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

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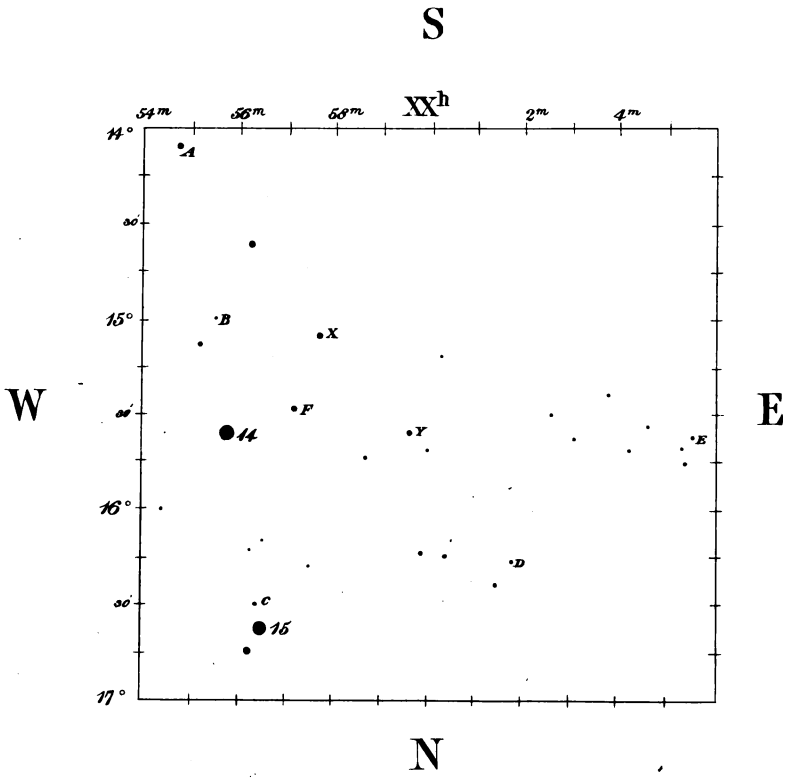
Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

MAP SHEWING THE POSITION OF
TWO NEW DOUBLE STARS IN SAGITTA.

Vide page



The Astronomical Register.

No. 118. OCTOBER. 1872.

ASTRONOMICAL ALLUSIONS IN HOMER, DANTE, SHAKESPEARE, AND MILTON.

By G. J. Walker.

I.—Homer.

When we consider that the Homeric poems, with the exception of the earlier books of Scripture, and some of the Indian Vedas, are more ancient than any other composition known, everything connected with them, apart from their intrinsic beauty, must be of great interest. The object of the first part of this paper is to collect the scattered allusions to the heavenly bodies that are found in these wonderful poems. Regarded in the light of a page of descriptive astronomy, of an antiquity (roundly stated) of 3,000 years, this may not be altogether foreign to the scope of a scientific association.*

Homer seems to have conceived the universe as a hollow globe, divided into two equal portions by the flat disk of the earth ; a circular, or as Mr. Gladstone† thinks, an oval disk, having a shorter diameter from east to west than from north to south, and round which flowed the Ocean-river. The superior and inferior hemispheres were respectively called Heaven and Tartarus. The latter was filled with eternal darkness. The concave sphere of heaven is sometimes represented as being of copper (Il. xvii. 425,‡ "all copper" ; Il. v. 504; Od. iii. 2), and sometimes of iron (Od. xv. 329 ; xvii. 565) ; a variation which may lead to the inference that its firmness and solidity are rather signified than its literal material. Such a *firmament* seems to correspond with the popular view of the ancient Hebrews, except that with them it seems to have been transparent like crystal or sapphire. The following passages from the book of Job may be compared with the Homeric view of the Kosmos ; bearing in mind that Scripture speaks according to the appearance of things, and is not to be placed in opposition to true science ; nor have the opinions of individuals therein recorded on physical matters of necessity the authority of Revelation :

* This paper was read before the Hackney Scientific Association.
† *Studies on Homer and the Homeric Age.*
‡ The edition quoted is that of Bekker, Berlin.

"He hath drawn a circular bound upon the waters,
To the confines of the light and darkness"
Job xxvi. 10. (Barnes.)

"Hast thou with him spread out the sky,
Which is strong, like a molten mirror?"
Job xxxvii. 18.

Even now we often speak of the vault or the canopy of heaven.

On the solid heaven, the stars, in the astronomy of Homer, seem to have been regarded as fixed and to revolve with it; whilst the sun, moon, and the morning and evening stars (regarded as distinct) moved through void air. It is also probable that there was supposed to be an opening in the solid vault through which the peak of Mount Olympus stretched upward into heaven.

THE SUN is invoked as one "Who surveys all things and hears all things," Il. iii. 277; Od. xi. 109, xii. 323. The latter clause, as Mr. Gladstone remarks,* involves impersonation, and he refers to Il. xviii. 239. where the sun is made to set *unwillingly* before the proper time, as the only other instance of the kind in the Iliad. "The untiring Sun" was figured on the shield of Achilles (Il. xviii. 484). His course is called "Lucăbas," or the Path of Light, Od. xiv. 161, xix. 306. The "Turnings of the Sun" are said to be in the Island of Suria (Syra), Od. xv. 404. If this expression refers to the tropics, as undoubtedly in Hesiod in several places, it is difficult to understand it unless by adopting the ingenious explanation which supposes that there was in this island a *parapegma*, *i.e.*, a tablet inscribed with astronomical or chronological observations, a sort of kalendar in which the sun's course and the seasons, &c., were marked. This idea seems to have been adopted by Pope—

"There curious eyes inscrib'd with wonder trace
The sun's diurnal, and his annual race."

Or it may have been a gnomon with the tracings of the shadow paths at the summer and winter solstices. It is curious that long after the time of Homer, Pherecydes (cir. B.C. 500), a native of Syra, is said to have constructed a sun dial on that same island. Something of the sort, very rare or even unique amongst the Greeks in the age of Homer, and probably of Phœnician origin, may account for the allusion in the above passage.

The similes or comparisons derived from the sun are the following: The interior of the house of Menelaus had the "radiance of the sun or the moon," Od. iv. 45. The same is said of the exterior of that of Alcinous, Od. vii. 84. The *khiton*, or tunic, of Ulysses was "bright as the sun," Od. xix. 234. The *pharos*, or shroud, woven by Penelope, was "like the sun or moon," Od. xxiv. 148.

THE MOON.—The "full moon" was represented on the shield of Achilles, Il. xviii. 484, from which "light beamed as from the moon," Il. xix. 374. The horse of Idomeneus had on its forehead a white mark, "running round like the moon," Il. xxiii. 455. The description of a bright moonlight night, Il. viii. 555-60, in Pope's translation, is often admiringly quoted:

"As when the moon, refulgent lamp of night!
O'er heaven's clear azure spreads her sacred light,
When not a breath disturbs the deep serene,
And not a cloud o'ercasts the solemn scene;
Around her throne the vivid planets roll,
And stars unnumber'd gild the glowing pole,

* *Studies, &c.*, 2, 261.

O'er the dark trees a yellower verdure shed,
And tips with silver every mountain's head;
Then shine the vales, the rocks in prospect rise,
A flood of glory bursts from all the skies:
The conscious swains, rejoicing in the sight,
Eye the blue vault, and bless the useful light."

"A master-piece" indeed, as Smyth says (Cycle i. 119), but a great amplification of the original, as will appear by comparing the following literal version:

"As when in the heaven the stars about the shining moon
Appear very splendid, and the æther is calm;
And all the mountain peaks are displayed, and the farthest headlands,
And the dells; and beneath heaven the vast æther is cleft,
And all the stars are seen, and the shepherd is glad in his heart."

Venus is the only planet mentioned in the poems. The gleaming of the point of the spear of Achilles* is compared to the

"Star which moves amongst the stars in the depth of night,
Hesperus, the most beautiful star that there is in heaven."
(Il. xxii. 317, 318.)

It is mentioned again, Il. xxiii. 226, as Heōsphoros, the "Bringer of Morn" (the same as Phōsphoros, Lucifer),—

"Heōsphoros goes forth announcing light over the earth."

And Od. xiii. 93, 94,—

"When the brightest star had risen, which commonly comes announcing the light of Eos, Child of Morn."

Hesperus and Heōsphorus seem to be regarded as distinct in Homer. Pythagoras is said to have been the first to surmise their identity; according to others, Parmenides discovered it.

Stars.—Allusions to and similes from the "starry heaven," Il. iv. 44, viii. 46, xix. 128, Od. ix. 527, are frequent. The arms of Tudeides are described as "shining like fire," and like to the summer [or early autumn] star, which shines with greatest brilliancy when it has been bathed in ocean." (Il. v. 5, 6.) This is Seirius, or the Dog Star. The comparison to fire may possibly justify the inference that Seirius shone in the days of Homer with a deep orange or reddish light. Pope, indeed, settles the point with his

"Red star that fires the autumnal skies."

But this is not in Homer. Pope often mentions Seirius, and in Il. v. 864-5, he introduces "the rage of burning Seirius," when Homer is only speaking of a thick dark atmosphere produced by a burning wind. But the *name* Seirius does not ever occur in the original. The *Peplos*, vest or shawl, selected by Hecuba, "shone like a star" (Il. vi. 295). So did the one selected by Helen (Od. xv. 108). Astyanax, Hector's infant son, resembled a "beautiful star" (Il. vi. 401). Hector himself, moving about among the ranks of the Trojans, was like

"The noxious star which appears from among the clouds,
Very brilliant, and then again plunges into the overshadowing clouds."

Where Seirius is doubtless again meant. Pope renders,—

"As the red star now shows his sanguine fires," &c.

The breastplate of Achilles was "starry," that is, sparkling (Il. xvi.

* A different comparison is that of Dante, *Inferno*, cant. ii., where the eyes of Beatrice are said to be "brighter than the star of day." And *Purgatorio*, cant. xii., an angel is described—

"With visage, casting streams
Of tremulous lustre like the matin star."

134), and his horse-tailed helmet "shone as a star" (Il. xix. 381), expanded by Pope into

"Like the red star, that from his flaming hair
Shakes down diseases, pestilence, and war."

Apparently understanding a comet. And Achilles himself is beheld by Priam—

"Beaming brightly, as he hurried over the plain, like the star
Which goes forth in the late summer, and whose rays, very clear,
Appear among many stars in the depth of night;
Which they call also the Dog of Orion.
The brightest indeed is this one; but it has been created an evil sign,
And brings much burning heat to poor mortals:
Thus shone the copper round his breast as he ran."—(Il. xxii. 26-32.)

On the shield of Achilles were represented

"All the configured stars which gem the circuit of heaven,
Pleiads and Hyads were there, and the giant force of Orion.
There the revolving Bear (which the Wain they call) was insculptured
Circling on high, and in all its course regarding Orion,
Sole of the starry train which refuses to bathe in the ocean"
(Il. xviii. 485-89. Sir John Herschel's translation.)

The last verse seems to imply that whatever other constellations were known to Homer, neither the Little Bear nor the Dragon could be among them; since they, as well as the Great Bear, are always above the horizon in the latitudes of Greece and Asia Minor. We know for certain, besides, that the Little Bear was introduced into Greece from the East by Thales.

In Odyssey, v. 271-75, the last three lines just quoted are repeated verbatim. Ulysses at the helm, sailing from the Island of Kalypso, slept not

"Whilst looking at the Pleiades, and the late-setting Boötes,
And the She-Bear, which they also call the Waggon,
Which revolves there and watches Orion,
And alone is without a share in the bath of the Ocean."

Boötes is called "late-setting," because he descends below the horizon in an upright position, and therefore very gradually.

Meteors.—The descent of Athena from Olympus is compared to

"A star which the son of wily Kronos sends,
A portent to sailors or to a broad army of people,
Bright, and from it many sparks are sent forth."—(Il. iv. 75-77.)

"Pope," remarks Smyth (Cycle i. 213), "makes Homer say, in describing Minerva's rapid descent from heaven, to break a truce between the Grecians and Trojans:—

'As the red comet from Saturnius sent
To fright the nations with a dire portent,
(A fatal sign to armies on the plain
Or trembling sailors on the wintry main,)
With sweeping glories glides along in air,
And shakes the sparkles from its blazing hair.'

"Now it so happens," he continues, "that there is not a word about a comet in the original; but the simile evidently alludes to a falling star." The Prince of Poets, says, "And she rushed in haste from the peaks of Olympus, as the brilliant star emitted by the son of the sage Saturn, either as a sign to seamen, or to a broad array of hosts, and from which numerous sparks proceed." Pope, save his *trembling sailors*, makes a fine picture; but the passage is another instance showing that

"Our translators view
In Homer more than Homer knew."

And, after remarking that "the Middle Ages became the birth-time of the terror inspired by the presence of comets, and that they were deemed portentous among the Romans," he says, "But there is nothing in the more ancient writings to authorise a conclusion that they were regarded as objects of alarm in the earlier ages of the world." As the above is probably the most ancient description of a meteor that we have, it may be interesting to give it also in the version of our illustrious astronomer :—

"Down at once, from the lofty heights of Olympus, she darted ;
As when a meteor sent by the son of mysterious Kronos
(Glides through the air), a portentous sign to fleets and to armies,
Scattering abroad unnumbered sparks (from its fiery tresses),
Thus sped Pallas, Athena," &c.

Pope, however, was resolved to find comets in Homer, for again, Il. iv. 381, when the latter merely says—

"But Zeus hindered, displaying unfavourable signs,"

our great poet has,

———"But Jove forbad from heaven ;
While dreadful comets glaring from afar,
Forewarned the horrors," &c.

Eclipses.—There is no allusion to eclipses in Homer, unless the passage, Od. xx. 356-57, "And the sun has utterly perished from heaven, and an evil gloom is overspread," in the vision (or as Mr. Gladstone well terms it, "the magnificent phantasmagoria") of the Seer Theoclymenos, may be supposed to have to have been suggested by such a phenomenon. Eustathius, indeed, supposes the occurrence of a real eclipse, observing also that it was new moon when the festival was being held. But it is evidently only a figure, and rather dubious whether it relates to an eclipse.

In his masterly work already referred to, Mr. Gladstone remarks on the weakness in Homer of the faculties of number and of colour. "The largest number," he says, "which I find in the Poems with any sign of definite use, is that of the fat hogs under the care of Eumaios (Od. xiv. 20). They are 360 ; and, as one is daily sent down to the banquet of the Suitors, they correspond with the days of the year."* The year was probably divided into 12 lunar months of 30 days each. Each month was also commonly divided into two periods according to the increase and decrease of the moon. Months are mentioned, Od. x. 14, xii. 325, xx. 156, xxi. 258. From the new until the full moon was the *beginning*, and while the moon decreased the *ending* of the month. Od. xiv. 162, xix. 307. So in Hesiod.

There are three seasons in Homer : 1. Spring, Od. xix. 529 ; 2. Summer, Od. vii. 118 ; 3. Winter, Il. iii. 4. In Hesiod, whose age is less ancient, the changes of the seasons and agricultural works were determined in a rough way by the risings and settings of Orion, the Pleiades, the Hyades, Arcturus, and Seirius. The heliacal rising of Seirius (*i.e., its first visible* rising in the morning twilight) in the time of Homer was *about the middle* of July. Hence its epithet already referred to of "*the (late) summer star*" (Il. v. 5, xxii. 26). The night was divided into three parts or watches. Thus, Od. xii. 312, xiv. 483,—

"But when it was the third watch of the night, and the stars had passed over,"

i.e., completed their nightly course and disappeared in the twilight.

After an elaborate investigation, Mr. Gladstone concludes that, whilst Homer had a very vivid perception of light not decomposed, as varying between light and dark, white and black, his perceptions of colour were

* Juventus Mundi, p. 538.

very indeterminate, and he has no words which can certainly be held to mean orange, green, and blue. The only two places, Il. xi. 27, xvii. 547, in which the rainbow is mentioned support this conclusion. If the great poet's grasp of number was so feeble, as it seems to have been, we may presume that he would have had difficulty in comprehending the famous catalogue of stars made by his illustrious countryman Hipparchus, about a millenary of years after his time; and, perhaps, yet greater difficulty in appreciating such a chromatic scale of their colours as the late Admiral Smyth devised.

Note.—How the sun passed from west to east does not appear in Homer. Between the notions of his reviving and perishing every day, as held by Epicurus, and of his shining in other regions when he has left our own, Lucretius and Virgil both hesitate. Mimnermus (cir. B.C. 600) is the first who records the myth that the sun after setting is carried round the earth in a golden bowl (made by Hephœstos) along the Ocean-river, back again to the east. This is also related by Stesichorus who lived about the same time.

II. Dante.

Born A.D. 1265; d. 1321.

Amidst the numerous astronomical allusions in this great poet, it will suffice to select a few: for we have not here the antiquity which makes the least fragment of Homer interesting; and the learned Florentine knew nothing better than the Physics of Aristotle, and the system of Ptolemy. At the end of the "Inferno," Dante, having descended through the different stages of the infernal regions, describes the great effort required to pass from one side of the earth's centre to the other. His guide, Virgil, explains to him,

—"When I turn'd, thou didst o'erpass
That point, to which from every part is dragg'd
All heavy substance."*

On which one of the commentators remarks that, "if this passage had chanced to meet the eye of Newton, it might better have awakened his thought to conceive the system of attraction, than the accidental falling of an apple;" which does not seem to evince much acquaintance with our immortal philosopher's real discovery.

On issuing from the interior of the earth, at the antipodes of Jerusalem, near the isle and mountain of Purgatory, the poet says,

"To the right hand I turn'd, and fix'd my mind
On the other pole attentive, where I saw
Four stars ne'er seen before save by the ken
Of our first parents. Heaven of their rays
Seem'd joyous. O thou northern site! bereft
Indeed, and widow'd, since of these deprived."

(Purgatorio, cant. i.)

That this refers (besides the mystic sense) to what is now called the "Southern Cross," there can be little doubt. Its four principal stars originally formed part of the Centaur. Humboldt, quoting the above celebrated passage, observes, "Dante and Amerigo Vespucci,—who at the aspect of the southern firmament in his third voyage first recalled these lines, and even boasted that 'he now beheld in his own person the four stars never before seen save by the first human pair,'—were still unacquainted with the denomination of 'Southern Cross.' Vespucci says simply that the four stars form a rhomboidal figure (una mandorla); and this remark belongs to the year 1501. As sea voyages

* Cary's translation is used throughout.

round the Cape of Good Hope and in the Pacific Ocean, by the routes which Gama and Magellan had opened, multiplied, and as Christian missionaries pressed forward into the newly-discovered tropical lands of America, the fame of this constellation increased more and more. I find it first mentioned as a 'wondrous cross (croce maravigliosa), more glorious than all the constellations of the entire heavens,' by the Florentine Andrea Corsali (1517), and afterwards in 1520 by Pigafetta. The Florentine extols Dante's 'prophetic spirit,'—as if the great poet had not possessed as much erudition as creative genius,—as if he had not seen Arabian celestial globes, and held communication with many Oriental travellers from Pisa."*

As the date of the celebrated "Borgian Globe" is A.D. 1225, Dante might have seen either it or another similar one, when the "Southern Cross" was still placed on the hind quarters of the Centaur. Allowing for a certain degree of poetic license, perhaps the first idea suggested by the above passage is the disappearance of the Cross from northern latitudes, owing to the precession of the equinoxes, first discovered by Hipparchus. But, besides that this constellation was still visible at Alexandria in the time of Ptolemy, it must be borne in mind that Dante places the terrestrial Paradise on the summit of the Mount of Purgatory in the Antarctic Ocean, and makes Adam declare (Paradiso, cant. xxvi. end.) that he was in it only six hours. Notwithstanding, then, that the poet speaks of our "widow'd northern site," "bereft" of this constellation, it seems plain he wishes to be understood that the north never enjoyed the sight of it,—a sight the beauty of which is enhanced by the intensity of light of the Milky Way in its vicinity. As Capt. Jacob, quoted by Humboldt,† says, "Such is the general blaze of starlight near the Cross from that part of the sky, that a person is immediately made aware of its having arisen above the horizon, though he should not be at the time looking at the heavens, by the increase of general illumination of the atmosphere, resembling the effect of the young moon." All who have had the opportunity of seeing the southern heavens will recognise the truth of this description; but, admitting that we have nothing to show in our latitudes like it, nor anything like the unique spectacle of the Magellanic clouds, and the "coal sacks," the view of our heavens looking south, when Orion is on the meridian, goes far to make amends for our loss and "widow'd condition."

In Purgatorio, cant. viii., we read,

"My insatiate eyes
Meanwhile to heaven had travel'd, even there
Where the bright stars are slowest, as a wheel
Nearest the axle; when my guide inquired:
'What there aloft, my son, has caught thy gaze?'
I answer'd: 'The three torches, with which here
The pole is all on fire.' He then to me:
'The four resplendent stars, thou saw'st this morn,
Are there beneath; and these, risen in their stead.'"

The Milanese astronomer, De Cesaris, considered that the three torches were Canopus, Achernar, and Fomalhaut;‡ and this (besides their mystic sense) appears very probable. Of these fine stars, almost in a line with each other, Achernar is the central one, and nearly equidistant (about 49°) from the other two. Adjusting the globe to Lat. 32° S., it will be

* Cosmos, 2, p. 292.
† Cosmos, 3, note 254, lxv.
‡ Cosmos 2, xcv.

found that when the Cross has set, Achernar is approaching the meridian; Fomalhaut, which passes very near the zenith, is high up in the east, and Canopus declining in the west.

The Milky Way is mentioned, Paradiso, cant. xiv.

> "As leads the galaxy from pole to pole,
> Distinguish'd into greater lights and less,
> Its pathway, which the wisest fail to spell;'—

And different opinions about it Dante instances in the "Convito." The telescope of Galileo revealed its true nature; but that had been divined two thousand years before by Democritus, and by Manilius at the beginning of the Christian era.

The description of a meteor, Paradiso, cant. xv., is interesting to compare with Homer's.*

> "As oft along the still and pure serene,
> At nightfall, glides a sudden trail of fire,
> Attracting with involuntary heed
> The eye to follow it, erewhile at rest;
> And seems some star that shifted place in heaven,
> Only that, whence it kindles, none is lost,
> And it is soon extinct."

The following curious mode of expressing a moment of time occurs in the opening of the xxix. canto of the Paradiso:—

> "No longer, than what time Latona's twins
> Cover'd of Libra and the fleecy star,
> Together both, girding the horizon hang;
> In even balance, from the zenith poised;
> Till from that verge, each, changing hemisphere,
> Part the nice level; e'en so brief a space
> Did Beatrice's silence hold."

"Latona's twins" are, of course, Phœbus Apollo and Artemis, in the post-Homeric mythology equivalent to the sun and moon. The "fleecy star" is Aries. The moon is on the horizon, precisely in opposition to the sun, likewise on the horizon; as Mr. Cary says in his note, "As short a space as the sun and moon are in changing hemispheres, when they are opposite to one another, the one under the sign of Aries, and the other under that of Libra, and both hang, for a moment, poised as it were in the hand of the zenith."

In Paradiso, cant. ix., the shadow of the earth is said to reach as far as Venus. There are allusions to the spots on the moon in the Inferno, cant. xx.

> "But onward now:
> For now doth Cain with fork of thorns confine
> On either hemisphere, touching the wave
> Beneath the towers of Seville."

"By Cain and the thorns, or what is still vulgarly called the Man in the Moon, the poet denotes that luminary" (Cary). And in Paradiso ii. the "fabling quaint" about Cain is followed by Beatrice's explanation of the spots,—as little worth attention as that of the Angel to Adam in Paradise Lost, v. 420. On "the Man in the Moon," most nations have

* And Virgil's. Georg. i.

> "Oft shalt thou see, ere brooding storms arise,
> Star after star glide headlong down the skies,
> And, where they shot, long trails of lingering light
> Sweep far behind, and gild the shades of night."

Sotheby.

traditions. Grimm in his Deutsche Myth. has collected a great many. (*English Cyclop.*) The Indians fancied the figure of an antelope or gazelle in the moon; a resemblance not very far-fetched: hence the Sanskrit names for the moon, Mrigalanchana and Mriganka, signifying that which has the mark or sign of an antelope; Mriga being an antelope.

EXTRACTS FROM GENERAL OBSERVATIONS ON THE TOTAL ECLIPSE OF DECEMBER THE 12, 1871.

BY R. F. CHISHOLM, F.R.I.B.A., &c., &c.,
Consulting Architect to the Government of Madras, and Member of the Avernashy Eclipse Expedition.

The telescope used was an excellent one by Cooke. After describing the preparations made for the observation, and the first part of the eclipse, the writer says, "After watching for a few moments the jagged edge of the descending moon's limb, I turned to observe the scene around me. The whole aspect of nature had changed. The greens on my right hand had become paler and bluer, a cold violet tinged the lights, and all shadows were sensibly darkened.

The *unearthly* aspect so often described during eclipses seems to me more due to the absence of diffused light than to actual change of colour. Comparing my sun-lit view with the scene before me, it was as if a gigantic electric light had been substituted for the sun. Turning again to the celestial bodies, the progress of the moon, hitherto so slow, gained apparent rapidity with every moment, and the excitement of watching it was not unlike a prolongation of that experienced at a well-contested horse-race, where the distant horses which appear to move so easily gain speed at every stride, until they rush by with bewildering rapidity. Here, as I watch, the moon appears to close down faster each succeeding moment; a low-lying plateau on the north cusp ending in a high excrescence now detaches a narrow strip of light,—a moment obliterates it! Through a deep valley glistens a bead of light, almost instantly blotted out by the surrounding lunar mountains!—Only a fine thread of sunlight remains—it breaks into beads of light, which vanish like the fading sparks on a piece of charred paper. A moment's hesitation, and I drop the dark glass. A fitful glimmer of direct sunlight quivers for a moment like the last muscular action of life—and dies, as the majestic sweep of the corona gives birth to a new and more beautiful existence—while, instantaneously with this marvellous change, the pall-like shadow passes by and casts everything in gloom—for a moment, earth, moon and sun are linked together by light and shadow! and then, all is still!—nature has reached a point of perfection, and seems to pause! Up to the instant of totality, the motion of the heavenly bodies had been so rapid that fancy almost created a sound; you fancied you heard the whirl of the moon rushing on through space—the lessening roar of the fierce solar rays as the two orbs, momentarily folding together, moved slowly over the deep blue of the sky, while a chance cool breeze gave intense reality to the rush of the shadow, sweeping on at the rate of some 40 miles a minute,—and now, all seems perfectly still! not a gleam on the moon's edge,—not a flicker in the corona,—no alteration in either the positions or lengths of the streamers,—no variation in the surrounding

scene. For two minutes and nine seconds, until the entombed sun bursts forth into new life with startling suddenness, like the explosion of a meteor of unprecedented brilliancy, the scene seems wonderfully typical of the stillness of death!

Perhaps the most astonishing sensation during totality arises from the additional glimpse obtained of creation. We are, as it were, taken behind the scenes, and permitted to see a portion of that marvellous and everlasting machinery which produces light, warmth, and life,—to gaze on flames of incandescent hydrogen, thousands and thousands of miles high, inexhaustable and unquenchable fire! And when we reflect that this mass of blazing, burning matter emits so feeble a light at this enormous distance, that the sensitive retina is not even momentarily pained by looking at it, the mind fails to grasp any conception of the intense heat and brilliancy of that underlying photosphere, the slightest chink of which can only be looked at through a dark glass!

For a few seconds after totality, I could not remove my eye from the telescope, the scene was too novel. I was struck particularly with the exquisite softness of the whole phenomenon, and the tender tones of colour. I had not for one moment imagined that the moon would be an 'intensely black object' surrounded by a fringe of 'dazzling brilliancy,' hence I had prepared the series of diagrams noted above; but I was a little startled to find it appear a comparatively light tint of delicate brown, surrounded by mellow tints of exquisite softness. The whole effect was one of rich harmonious warmth. The prominences (chiefly crimson and orange) were defined clearly, and the corona, a yellowish orange light near the sun, passed through violet into the cold neutral of the sky. After gazing for a few seconds I attempted to sketch the two lower flames, one of which was particularly striking; but unfortunately my hand shook so with the previous excitement that I could do little more than indicate their position, and sketch the flames themselves on a larger scale. Taking a second good look to be certain of their position and colours, and noting two more I had not previously seen, I rose to take a look round at nature. All the *unearthly* appearance had vanished during totality, and the landscape had been changed to twilight with the first streaks of morning round the horizon. Venus in the zenith, and the few larger stars, looked exactly as these bodies look during twilight, except that the sky had lost that depth of blue common to such moments. It was as if a light film of Indian ink had been washed over a representation of early morning. The eclipsed sun shedding its soft streamers round our darkened satellite, decidedly gave place in brilliancy to Venus. There was still a good deal of diffused light, and I turned to my boards to see whence it came. Only the east side of the vertical board was illuminated; and this with peculiarly the same tone and strength that I had observed before sunrise. I at first imagined this to be the light of the corona. Had it been so, however, the sun being some 20 degrees above the horizon would certainly have illuminated the upper part of the horizontal board. It appeared, then, that the whole amount of appreciable light came from the strip of apparent dawn below the line of clouds; that it was, in fact, the sunlight surrounding the shadow, reflected back in the air, and viewed through a medium of some 35 miles of dark atmosphere. If this surmise be correct, we can readily perceive the cause of the apparent discrepancies which exist between different observers in describing the relative effects of darkness. The light of the earth's reflection would diminish so rapidly with the altitude, that it would seem to me possible for a zenith eclipse, wholly obscured by dark clouds, with a clear horizon, to be as light as a fine summer morning

before sunrise; while, on the other hand, an eclipse with a clouded horizon, *within the circle of shadow*, might be as dark as the darkest starlight night. As a further proof of the very feeble light of the corona, may be noted the fact, that the eye, although weakened by gazing for some 15 minutes through a dark glass, is not even momentarily put out by the burst of the corona; while a telescope of ordinary power, brought suddenly to bear on the moon, renders it too bright to be looked at without a painful sensation.

I noticed that the corona, by the unaided eye, appeared a soft yellowish light, almost colourless. Remembering the expression of warmth I saw in the telescope, I again looked through the instrument: by this time the moon had moved half out of the field, and I saw the full breadth of the south-west portion, which was most decidedly a yellowish orange, fading through violet into the surrounding darkness. A fringe of crimson prominences on the west warned me of the progress of the phenomenon, and I proceeded to compare my landscape with the actual view in the camera. Both being on the same scale, the comparison was peculiarly easy; indeed, I think the precautions I took unnecessary. Any one accustomed to sketch from nature could with ease have retained the scene by memory. I had just seized my pencil with the intention of tracing the streamers and corona. I had marked the moon, the corona, and one streamer, when the first blaze of sunlight burst forth; I had thus an opportunity of seeing the whole effect of this burst concentrated on a few square inches of paper. By the time I had collected my drawing materials it was light enough to commence work; and in three hours I had completed sketches of the landscape and corona, sufficiently close to enable me to represent very fairly the observed phenomena.

The figure of the corona was not regular; neither were the streamers placed symmetrically. The greater breadth of the former appeared to be on that side towards which the sun was approaching.

NEW EQUATORIAL TELESCOPE FOR THE ROYAL OBSERVATORY.

(From *The Scotsman.*)

The insufficiency of the equatorial telescope in the Royal Observatory Calton Hill, for the requirements of modern astronomical science, has long been a matter of notoriety, and Professor Piazzi Smyth has not for twenty years ceased to urge upon every successive government the necessity of raising the metropolitan observatory of Scotland from the position of the meanest appointed government institution in Europe. The perseverance of the Astronomer-royal for Scotland was at length rewarded, and last year a sum of 2,300*l.* was placed in the estimates for the purpose of providing an improved equatorial telescope. But after Parliament had ratified the proposal of the government, that a new instrument should be secured for the observatory of the Scottish metropolis, a limit was put on the aspirations of the Astronomer-royal as to the size of the telescope. The new telescope, of course, involved a new dome, and it was referred to an architect of taste to see how much the new dome to be placed on the beautifully proportioned building on the Calton Hill should exceed the old one in size. The architect selected by the government was Mr. James Fergusson, the author of "The History

of Architecture," and he decided that the new dome could not be raised more than fourteen inches—that being the largest increase that could be æsthetically allowed in conjunction with the rest of the Observatory, which, viewed as a piece of architecture, is considered to be the very gem of the works of the late William Playfair. In consequence of this the Astronomer-royal has had a difficult task in endeavouring to arrange a form of equatorial instrument which would give a greater amount of power within a smaller line or compass than was ever attained before. The new telescope will have an aperture of two feet upon a focal length of only ten feet, a larger diameter in proportion to focal length than any astronomical telescope yet introduced into any observatory, and it will no doubt be by far the most powerful instrument ever erected under so small a dome. Although the telescope will be much more powerful than any ever before placed in the Observatory, it is still not such as was desired or considered almost necessary in the present state of science. The instrument, which is being built by Mr. Howard Grubb, Dublin, is to be of a comparatively new order of reflecting telescope. The old reflecting telescopes, such as those of Lord Rosse, had their reflectors made of a mixture of copper and tin. Mons. Foucault, of the Paris Observatory, the celebrated inventor of the pendulum experiment for determining the revolution of the earth, discovered that a better reflector could be secured by making the body of the speculum of glass, and then coating it by a chemical process with pure silver. The new Edinburgh telescope will have one of these glass silver-covered speculums. The instrument is intended to be employed in two comparatively new branches of observing astronomy—photography and spectroscopy. Both these classes of research require the seemingly impossible accompaniments—that the telescope must have the utmost amount of firmness, and also have the most accurate possible movement, at the same rate at which the stars are going round in the sky. For if, during the time that an observation is being proceeded with, the slightest tremor or shaking should happen, or if an error in the movement of the telescope in its arc, with a radius of five feet (half the length of the telescope), should occur to the amount of even one three-hundredth part of an inch, the star and its spectrum would entirely vanish from the field. Notable features in the new telescope will, therefore, be the remarkably perfect clock-work apparatus, the several devices connected with the prisms of the spectroscope, the means by which not merely celestial objects will be kept in view; but those by which the rays of chemical flames will be brought into comparisou with the light of the stars. The extremely delicate measuring apparatus, to be applied to the respective subjects as they appear on the spectrum. will also be noteworthy. December next is the time fixed for the completion of the new instrument, but meanwhile active preparations are being made in the Royal Observatory for its reception. The old wooden dome which surmounted the building has been removed, and Playfair's grand pier, resting on the solid rock, is being furnished with a new capital to suit the increased size of the new telescope. The new dome, it is expected, will be erected in the course of next month, while the weather is yet fine. This dome, which is also being built by Mr. Howard Grubb, Dublin, will be of iron instead of wood, and that for two reasons: first, because it will afford a greater amount of space in the interior of the instrument room; and second, because it will enable such an arrangement being made for the shutter, as will allow of an opening several feet in breadth, whereas the opening in the old dome was only a few inches wide. The new works involve a considerable amount of alteration, especially in the interior of the Royal Observatory, and these, so far as

archictural points are concerned, are being carried out under the efficient supervision of Mr. R. Mathieson, of Her Majesty's Office of Works in Edinburgh. Although the arrangements of the observatory are, during operations, necessarily somewhat upset, observations continue to be made by Professor Piazzi Smyth and his assistants. Nothing is allowed to interfere with the usual time signals which emanate from the Observatory daily.

We are informed by the Astronomer Royal that the new dome alluded to is now erected and admirably fulfils all the expectations formed of it, such as increased space inside, greater ease of revolution, larger and more easily worked shutter, better ventilation, and freedom from vibration and bumping. This latter curious quality was a very vicicus propensity of the old dome, partly from its being mounted on cannon balls which enabled it to roll in every other direction as well as in that of the line of railway, wherein alone it was wanted to roll; and partly from the unprecedentedly windy and stormy exposure of the Edinburgh Observatory on the summit of the Carlton Hill. The new dome, therefore, may be considered a very creditable piece of engineering, and a decided success on the part of Mr. Howard Grubb, who is admirably keeping up the credit of the great optical and instrumental establishment founded by his eminent father in Dublin.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

NOTE ON APPENDIX TO DR DE LA RUE'S ADDRESS TO THE BRITISH ASSOCIATION **(SECTION A.),** ***BRIGHTON MEETING,*** **1872.**

This appendix states that Professor Zöllner finds "gas-density on the earth's surface 10^{246} times greater than in space; that a litre of former would fill a sphere of latter's density, whose radius would be traversed by light in not less than 10^{98} years, and that the air round the moon is 10^{332} times less dense than at earth's surface."

Are these enormous *exponentials* correct? Light, moving at 192,000 miles a second, will traverse in a year of 31,000,000 of seconds, a line of 5952×10^9 miles, or above $\frac{3}{8} \times 10^{18}$ inches; the radius of a sphere whose volume is $883{,}227 \times 10^{33}$ cubic miles $= 22\frac{1}{8} \times 10^{346}$ cubic inches.

A litre contains 61,0270772 English inches, which as a sphere gives a radius of

$$\sqrt[3]{61.\ldots \times \frac{3}{4\pi}} = 2.44237 \text{ inches};$$

a density of 10^{-246} gives a radius of $244{,}237 \times 10^{77}$ inches $= 385475 \times 10^{72}$ miles; results do *not* agree, even introducing the factor $800 =$ density water to that of air. I believe Sir William Herschel showed that if the stars revolved (*à la Ptolemy*) round the earth, one at an annual parallax of a second of space would make a diurnal revolution of $206265 \cdot 19.10^7\ \pi$, or 1231.10^{11} English miles, a *moderate* estimate, compared to the above ungraspable magnitudes.

74, Offord Road, N.: S. M. DRACH.

August 21, 1872.

ANCIENT ECLIPSES.

My dear Sir,—Referring to the contents of the slip you have sent me, the correct date of the eclipse of 1433, is June 17; there was a misprint in a recent communication of mine in *The Times*. The *central line* did not touch England, it passed from Stornaway (Lewis) to Abroath. The *southern* limit of totality ran from about five miles North of Carlisle to Spurn Head, at the mouth of the Humber. The 17th of June, in 1433, fell on *Wednesday*.

Ferguson says nothing to justify the inference that any one of the three eclipses named was total in England; indeed, the eclipse of 1633, October 3, was *annular*, though I see it is given total in Ferguson's list.

While writing on this subject I may just mention that the eclipse of 878, October 29, in the days of King Alfred, to which attention was lately directed by the Rev. J. S. Johnson, comes out total in London by a rigorous computation. I find totality began at 1h. 16m. 20s. mean time, and continued 1m. 51s. The shadow ran thus, near our meridian:—

	N. limit	Central line	S. limit
Long.	Lat.	Lat.	Lat.
1°W	+53°.18′	+52°. 5′	+50°.56′
0°	53 . 1	51 .48	50 .40
1°E	52 .45	51 .33	50 .25

London, therefore, some 20 miles south of the central line.

I am, dear sir,
Yours very truly,
J. R. HIND.

Mr. Bishop's Observatory,
Twickenham, 1872, August 28.

Much having been recently published on the subject of historical eclipses, it may not be inopportune to continue a brief description of those recorded in the Saxon Chronicle. For such a purpose it will hardly be deemed necessary to have the time to the nearest second; but if it should be within even a quarter-of-an-hour or so, it will suffice. The following eclipses have been computed from the same tables I used for the "Future Solar Eclipses." Though expeditious, they afford a very fair approximation to the time. Having already commenced this subject in No. 104 (to which two corrections at the foot of page 220 in September's *Register* should be applied), I shall omit the eclipses previously mentioned,—those of 733, 828, 1110, 1117, 1133, 1140. The translation of the Saxon Chronicle used is Ingram's (1823).

"538. This year the sun was eclipsed 14 days before the calends of March, from before morning until nine." An eclipse of the sun on the morning of February 15th, appears to have attained its greatest obscuration at London about 7h. 43m., and that was 8 digits.

"540. This year the sun was eclipsed on the twelfth day before the calends of July, and the stars showed themselves full nigh half-an-hour over nine."

I make the sun's eclipse on the morning of June 20th to have amounted to two-thirds on the lower limb about 7h. 37m. Sem. of sun almost as small as possible. Sem. of moon about as large as it could be. Totality must have been far south of Great Britain.

"664. This year the sun was eclipsed on the 11th of May; and Erkenbert king of Kent having died, Egbert his son succeeded to the kingdom."

On May 1st I find a very large partial eclipse of the sun, the maximum obscuration soon after 5h. in the afternoon, when only a thin crescent would be uncovered at the S. of the sun. It must have been total in England north of London.

"795. This year was the moon eclipsed between cock-crowing and dawn on the fifth day before the calends of April, and Erdulf succeeded to the Northumbrian kingdom on the second before the Ides of May."

The eclipse meant must be that of March 28, 796. It began about 4h. in the morning, was total for nearly an hour, and ended below the horizon about half-past 7. The moon would set totally eclipsed.

"800. This year was the moon eclipsed at eight in the evening on the 17th day before the calends of February, and soon after died King Bertram and Ealdorman Worr."

An eclipse of the moon on the evening of January 15 began at 7h., middle about 8h. 34m, the obscuration being nine-tenths of the moon's upper limb. End about 10h. 8m.

Upton Helions Rectory, S. J. JOHNSON, F.R.A.S.
Crediton: Sept. 3.

NEW MINOR PLANETS.

(121) May 12th, 1872, by Mr. Watson—Michigan.
(122 and 123) July 31st, 1872, by Dr. C. H. F. Peters—Hamilton College.
(124) August 23rd, 1872, by Dr. C. H. F. Peters.
(125) September 11th, 1872, by M. Prosper Henry, of the Observatory, Paris.

Dear Sir,—This year promises well for the minor planets, those modest *sorores minores*, who now and again woo our attention by additions to their number. The 8th, of 1872, whose number in the group is (125) disclosed itself on the night of September 11th, at the Observatory of Paris, to the watchful eye of M. Prosper Henry. We should welcome this new accession to our astronomical wealth, and also this new planet-finder, and nothing the less because he is of the old world, which needs much to have its bands of observers and labourers recruited.

During the past ten years our obligations, as regards the subject of M. P.'s, are mainly due to our very worthy cousins of the new world.

Our leading members at home, especially those of the R.A.S., have of late given their attention very much to physical astronomy, and doubtless our science is deeply indebted to the spectroscope (what a mongrel appellative—the former part plainly *Latin* and the latter pure *Greek*), to photography and to chemistry; but surely we should not receive with indifference the announcements from time to time of new planets discovered, even should they be minor planets. Most of us remember the joy and rejoicing with which Astræa was welcomed, in 1845, and we all have read of the sensation and delight produced by the discovery of Ceres on the first day of this century. Surely, surely, the many additions in our day to that central group of planets call on us to give especial attention to them. The idea which was, for a long time, very general that these planets were fragments of one great body broken up by some convulsion, is now entertained by few. That theory is nearly exploded. Is it not reasonable that we should think-out some other,—*try again* sounds in our ears. May I hope, Mr. Editor, that your next number will contain some thoughts on THE MINOR PLANETS, thus making some atonement for past neglect and gratifying many of your humbler astronomical readers, especially your aged friend

Angela Gardens, Sept. 16th, 1872. SENEX.

TWO NEW DOUBLE STARS IN SAGITTA.

I desire to call attention to two new double stars near 14 Sagittæ, lately discovered with my 6-in. Alvan Clark refractor, one of which is a very beautiful but excessively difficult object. As this vicinity is particularly rich in double stars found by Struve, I give a diagram of all of these doubles, together with the brighter stars in their neighbourhood. The five from Struve, and 14 and 15 Sagittæ, are set down to scale for the epoch of *mensuræ micrometricæ* (1830), and the other stars carefully marked in. The new doubles are marked X and Y, and Struve's A, B, &c.

The position, angles, distances, and magnitudes of the several doubles in Struve shown on the map* are as follows:—

			Mags.	
A=Σ2616	P=265°·7	D=3″·3	6·8	9·7
B=Σ2618	115·9	5·3	8·6	8·9
C=Σ2622	194·8	6·2	8	8·7
D=Σ2634	13·8	6·5	8	9·5
E=Σ2651	279·9	1·5	8	8

2616 is a very beautiful pair, and perhaps the most difficult of the five. 2651 is also very pretty, but easy. Dembowski has observed another pair on the same parallel with 2618, of which he gives:—

P=213°·8 D=21″·65 Mags. 7·7 10·5 (*Ast. Nach.*, No. 1736.)

This will be found in the same field a little preceding. It is an easy but interesting double. The star marked F is also a wide double, resembling the last.

The first of the new doubles, X, is vastly more difficult than any of those cited; indeed, it seems to be one of the most difficult objects I have found, or been able to see, with my aperture. The magnitude of the primary is the same as Σ 2616, or about 7·5 of the scale of Smyth and Herschel. The distance of the companion is about 2″. The same evening I picked up two doubles in Cassiopea, afterwards identified as O Σ 511 and O Σ 512, the magnitudes being given as 11·12 and 11, which I found much easier than the one in question. The distances, however, are greater, being 10″·4 and 4″·14 respectively, for which some allowance should be made; but still they are both rather difficult. From this and other comparisons, including Σ 2616, which is certainly more than one magnitude brighter, I think the new double might be fairly rated as 11, giving nearly 16 of Herschel's scale.

The other pair, about 8 mag., marked Y, is comparatively easy. The companion is a very minute point, and fainter than any of Struve's, yet from its considerable distance from the principal star, about 10″ is very readily seen. I hope astronomers will observe these objects, particularly the first, and report, with measures or otherwise.

I may add that, being absent from home, I am obliged to use, temporarily, my object glass without the tube and mounting, and possibly may overrate the difficulty of the first pair from the very rude apparatus used, the object glass being simply fastened to one end of two narrow pieces of boards nailed together, with their planes at right angles, and the eyepiece attached to the other end. Although extremely unsteady, and requiring very frequent adjustment of the object glass, and inconvenient generally to use, it seems to answer all practical purposes.

S. W. BURNHAM.

Aug. 19th.

* *Vide* frontispiece.

THE PLANET MERCURY.

Sir,—I have read with much pleasure the correspondence that has recently appeared in the *Register* having reference to observations of Mercury, and quite agree with Mr. S. J. Johnson that this planet can be much more frequently seen with the unassisted eye than is generally supposed. In February, 1868, I saw the planet three times, viz., on the 15th, 19th, and 24th, and. in February of the following year, I saw it on the 2nd, 4th, 5th, and 6th. When I first observed the planet I was surprised at its brilliancy, which seemed to nearly equal that of Jupiter in February, 1868. On the 15th these planets were in close proximity, and therefore a favourable opportunity occurred to estimate their relative brightness. Mr. Hind has stated that Mercury, under the most favourable circumstances, appears like a star of the third magnitude; but there is good reason to suppose that the planet is much brighter than this. Mr. G. J. Walker says (*Astronomical Register*, vol. VI. p. 74) "it seemed to vie with Jupiter in splendour" on February 19th, 1868. I saw the planet on the same evening, and wrote in my note book: "Feb. 19th. Soon after Jupiter had set Mercury emerged from the clouds, which almost entirely overspread the sky except the western horizon, which was remarkably clear. The brilliancy of the planet surprised me, for he appeared to nearly equal Jupiter." On other occasions also he has been quite a conspicuous object near the horizon, and I am inclined to believe that his brilliancy is much greater than is usually imagined, and that the planet can be very easily seen (when sufficiently distant from the sun) under favorable atmospheric conditions.

I am, Sir, Your obedient servant,

Hollywood Lodge, Cotham Park, WILLIAM F. DENNING.
Bristol: August 2, 1872.

15 *MESSIER PEGASI.*

Sir,—We are indebted to the late Sir John Herschel for graphic descriptions of many of those splendid collections of suns which are usually designated globular clusters, and I hardly need to apologise for transcribing his word—portrait of one of the most interesting, whose name is mentioned above.

He says: Very bright, very large; gradually brighter, and very suddenly much brighter in the middle. A magnificent globular cluster comes up to a perfect blaze in the centre, like a protuberance or ripple; not the condensation of a homogeneous globe; it has straggling streams of stars, as it were, drawing to a centre. . . . Superb, very compressed, irregularly round; very small stars 15 mag., all distinct, but running together into a blaze in middle; 4′ or 5′ diameter.

Results of observation with the Parsonstown 6-ft. are given by the Earl of Rosse in the sufficiently terse "cl."

Observing with my 9-inch "With-Browning," and powers 212 and 320, on the 14th of Oct. 1868, I detected a dark patch in the brighter central part of the cluster. Every subsequent season enables me to give further particulars. There is a bright knot in the blaze towards its N. side which is probable H's "nipple." S. and a little *p*, the latter there is a black spot or vacancy, and there are fainter dark lanes leading outwards from this spot *p* and *f*—the latter the more prominent. This blaze is not clearly resolved, and the whole object is more difficult and requires better air than the Earl of Rosse's three lanes in 13 M. of Hercules.

The interesting question is suggested whether these peculiarities in

the cluster last mentioned and the great Andromeda nebula have any connection with the deficiency in the red end of their spectra, and I should be gratified by hearing the result of a careful examination of the spectrum of 15 Mes., with a large aperture.

In August, last year, I carefully examined 92 M. Hercules, having a spectrum similar to that of its neighbour 13 M., and made the following notes: Brighter stars, and more compressed than 13 M., but all the blaze is resolved by glimpses. Looked for darker portions, but could get nothing certain. Sometimes thought there was a darker space on *f* side.

Will some of your readers, possessing equal and larger apertures, kindly scrutinise these two clusters, and give us the results?

I am, Sir, yours truly,

Bonner's Road, Victoria Park: T. H. BUFFHAM.
Aug. 7, 1872.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN OCT., 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists for May, July, and September, 1871, may be consulted for objects suitable for observation in October, 1872. On May 21, 1871, the the value of ☾ —☉ was 152°, 21′ (see Vol. ix. p. 128). On October 4, 1872, the value is 151° 46′·0. The May list may, therefore, be used for October 4. The value of ☾—☉ on July 20, 1871, was 142° 24′·8 (see Vol. ix. p. 172); and on September 17, 1871, 138° 51′·1 (see Vol. ix. p. 217). On October 5, 1872, the value is 139° 27′·1. The two lists may, consequently, be used from October 5. Those observers who have recorded their observations will find it advantageous to compare them with those which they may make during the present month.

Tenth Zone of objects from North to South, 30° *to* 35° *W. long.*

Euctemon, Democritus, Mason, Grove (*a*), Daniell (*a*), Chacornac (*b*), Le Monnier,* Littrow, Maraldi,* Vitruvius, Censorinus, Isidorus, Fracastorius, Piccolomini, Stiborius, Hommel,* Schomberger (the west part).

The objects in this zone which are within 60° of the moon's west limb, in mean libration, may be looked for as early as the fifth day of the moon's age, October 7. If not in sun-light, on the 7th they are likely to be fine objects for study on the 8th; all the objects in the ten zones may be observed under the evening illumination after the full.

The labours of the Committee appointed by the British Association for discussing observations of lunar objects suspected of changes having terminated successfully, inasmuch as the solar influence in darkening the floor of the Crater Plato has been well-established, and numerical values assigned to the gradations of tint as the sun attains his greatest altitude, and also as he declines towards the horizon of Plato (see No. 112, pp. 95, 96), it becomes exceedingly important that observations of a similar character should not only be continued but extended. The Committee in its report, while alluding to the results of the discussion, among which may be mentioned changes in brightness of portions of the floor not referrible to solar altitudes, spoke of the desirability of telescopes of large aperture being employed in the further prosecution of this interesting and important branch of astronomical research, but did not recommend

(*a*) See list for January, 1872, note (*a*) on p. 27 of 109.

(*b*) The crater on the S.W. of Posidonius, named to commemorate the astronomical labours of Chacornac.

(*) The objects thus marked have not been mentioned in the monthly lists.

any immediate steps to be taken to ensure the carrying out of its suggestion, hoping that the Association would not overlook the enquiry in future years. Had the Committee in presenting its final report suggested to the Association an immediate course of action with the view of maintaining the interest hitherto manifested, it is not at all unlikely that it would have been re-appointed. As this has not been done the subject of lunar research is for the present left entirely in private hands, and there is much room for exertion during the next year in obtaining materials for confirming and elucidating the results arrived at by the Committee. The region S.S.E. of the Mare Serenitatis, containing several dark spots; among them Julius Cæsar and Boscovech are very suitable for observations of the kind discussed by the Committee.

There is an error in the article "British Association and Lunar Work." The Lunar Committee was re-appointed in 1868, but not in 1869. It was in 1870 that the Committee for discussing observations of objects suspected of change was appointed.

Rhœticus.—Several new objects having been detected on the N.W. of this spot, especial attention is directed to it and the rugged region surrounding it. The "fault" which has dislocated its W. and N. borders, extending to the west of Albategnius on the S.S.W., and to Ukert or beyond, as far as the Apennines on the N.N.E., is an interesting study under an early illumination.

Erratum.—No. 106, October, 1871, p. 240, October 18, for *Bohnenbeger* read *Bohnenberger*.

THE PLANETS FOR OCTOBER.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m
Mercury ...	1st	12 7 35	+ 1 7½	5″·0	23 21·7
	15th	13 29 55	− 8 40	4″·8	23 54·8
Venus ...	1st	13 50 11	−10 51½	10″·6	1 7·9
	15th	14 56 59	−17 0	11″·0	1 19·5
Jupiter ...	19th	9 56 27	+13 21	32″·0	20 0·1
Saturn ...	1st	19 4 10	−22 32¾	15″·2	6 21·0
	15th	19 6 9	−22 30½	14″·8	5 28·0
Neptune ...	3rd	1 36 21	+ 8 21		12 44·3
	15th	1 35 7	+ 8 1		11 55·0

Mercury is badly situated for observation.

Venus will be fairly observed towards the end of the month, setting an hour after the sun.

Jupiter may be well observed through the greater part of the night, rising shortly after midnight.

Saturn is still visible for about four hours after sunset, but very low.

Neptune is well situated for observation.

ASTRONOMICAL OCCURRENCES FOR OCTOBER, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn.
Tues	1	 6 50	Sidereal Time at Mean Noon, 12h. 42m. 5·95s. Conjunction of Moon and Mercury, 3° 5′ S.	1st Oc. R.	16 36	6 21·0
Wed	2	3 30	● New Moon Sun's Meridian Passage, 10m. 48·49s. before Mean Noon	1st Tr. E.	13 45	6 17·2
Thur	3	21 0	Conjunction of Moon and Venus, 2° 34′ S. Saturn's Ring: Major Axis=37″·90 Minor Axis=15″·89			6 13·4
Fri	4			2nd Sh. I.	17 6	6 9·5
Sat	5	18 31	Conjunction of Mars and α Leonis (10·2m.), W.			6 5·7
Sun	6			2nd Oc. R.	16 10	6 1·9
Mon	7			3rd Ec. R. 3rd Oc. D. 1st Sh. I.	15 51 22 16 12 17 54	5 58·1
Tues	8			1st Ec. D.	15 16 59	Moon. 4 51·5
Wed	9	9 3 5 14	☽ Moon's First Quarter Conjunction of Moon and Saturn 3° 25′ N.	1st Tr. I. 1st Sh. E. 1st Tr. E.	13 23 14 43 15 43	4 52·2
Thur	10			4th Tr. E.	16 22	6 52·9
Fri	11	9 20 9 29 10 26 10 48	Conjunction of Venus and α Libræ (4·6m.), E. Near approach of 33 Capricorni (5½) Occultation of 35 Capricorni (6) Reappearance of ditto			7 51·7
Sat	12	17 57	Superior conjunction of Mercury			8 47·5
Sun	13			2nd Ec. D.	13 53 51	9 40·2
Mon	14	5 52 6 53 9 4	Occultation of 33 Piscium (5) Reappearance of ditto Near approach of B.A.C. 17 (6)	3rd Ec. D.	16 16 7	10 30·3
Tues	15	 10 21 13 9 14 45	Illuminated portion of disc of Venus = 0·913 Illuminated portion of disc of Mars = 0·950 Near approach of 26 Ceti (6½) Near approach of 29 Ceti (6½) Near approach of 33 Ceti (6)	2nd Tr. E. 1st Ec. D.	14 2 17 10 21	11 18·9

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Wed	16	3 34	○ Full Moon	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	14 16 15 21 16 37 17 41	12 7·0
Thur	17	 11 14 5 54	Sidereal Time at Mean Noon, 13h. 45m. 10·80s. Opposition of Neptune and Sun Near approach of 31 Arietis (6)	1st Oc. R.	15 2	Moon. — 12 55·4
Fri	18	8 32	Near approach of B.A.C. 1096 (5½)	3rd Tr. E. 4th Ec. R.	14 7 17 2 7	13 44·9
Sat	19	8 55	Near approach of B.A.C. 1373 (6)			α Pegasi 9 4·9
Sun	20			2nd Ec. D.	16 28 59	9 0·9
Mon	21					8 57·0
Tues	22	10 56 15 18 16 0	Near approach of 52 Geminorum (6) Occultation of A Geminorum (5½) Reappearance of ditto	2nd Tr. I. 2nd Sh. E. 2nd Tr. E.	13 49 14 27 16 44	8 53·0
Wed	23	20 53	☾ Moon's Last Quarter Saturn's Ring: Major axis = 36″·68 Miuor axis = 15″·28	1st Sh. I. 1st Tr. I. 1st Sh. E.	16 10 17 18 18 20	8 49·1
Thur	24	4 0	Conjunction of Moon and Uranus 4° 6′ S.	1st Ec. D. 1st Oc. R.	13 31 54 16 58	8 45·2
Fri	25	22 41	Conjunction of Moon and Jupiter, 4° 40′ S.	1st Sh. E. 3rd Sh. E. 1st Tr. E. 3rd Tr. I. 3rd Tr. E.	12 59 13 40 14 7 14 37 18 19	8 41·2
Sat	26	2 10 6 0 15 46	Conjunction of Mars and χ Leonis, 0° 8′ S. Conjunction of Jupiter and ν Leonis,(8·5m.)W. Conjunction of Mars and χ Leonis, (1·2m.) W.			8 37·3
Sun	27	6 14	Conjunction of Moon and Mars, 4° 0′ S.			8 33·4
Mon	28					8 29·4
Tues	29			2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	14 5 16 30 17 1	8 25·5
Wed	30			1st Sh. I.	18 3	8 21·6
Thur	31	17 28	● New Moon	2nd Oc. R. 1st Ec. D. 1st Oc. R.	13 40 15 25 6 18 55	8 17·6
NOV. Fri	 1	10 8	Conjunction of Mars and σ Leonis (2·1m.), E. Conjunction of Moon and Mercury 2° 25′ S.	1st Sh. I. 1st Tr. I. 3rd Sh. I. 1st Sh. E. 3nd Sh. E. 3 Tr. I.	12 32 13 44 13 55 16 4 17 38 18 46	8 13·7

SUN.

Greenwich, Noon. 1872.		Heliographical western longitude of the centre of the sun's disc.			Heliographical latitude		Angle of position of the sun's axis.
		°			°		°
Oct. 1	...	282·02	13·21	...	+6·59	...	26·26
2	...	295·23	13·21	...	6·53	...	26·31
3	...	308·44	13·21	...	6·48	...	26·36
4	...	321·65	13·21	...	6·22	...	26·40
5	...	334·86	13 21	...	6·36	...	26·44
6	...	348·07	13·21	...	+6·30	...	26·47
7	...	1·28	13·20	...	6·24	...	26·49
8	...	14·48	13·21	...	6·17	...	26·50
9	...	27·69	13·21	...	6·11	...	26·50
10	...	40·90	13·20	...	6·04	...	26·50
11	...	54·10	13·21	...	5·97	...	26·49
12	...	67·31	13·21	...	5·90	...	26·48
13	...	80·52	13·20	...	+5·82	...	26·45
14	...	93·72	13·21	...	5·75	...	26·42
15	...	106·93	13·21	...	5·67	...	26·38
16	...	120·14	13·20	...	5·59	...	26·33
17	...	133·34	13·21	...	5·51	...	26·28
18	...	16·55	13·20	...	5·43	...	26·22
19	...	159·75	13·21	...	5·34	...	26·15
20	...	172·96	13·20	...	+5·26	...	26·07
21	...	186·16	13·20	...	5·17	...	25·98
22	...	199·36	13·21	...	4·99	...	25·89
23	...	212·57	13·20	...	4·99	...	25·79
24	...	225·77	13·20	...	4·90	...	25·68
25	...	238·97	13·20	...	4·80	...	25·56
26	...	252·17	13·21	...	4·71	...	25·43
27	...	265·38	13·20	...	4·61	...	25·30
28	...	278·58	13·20	...	4·51	...	25·16
29	...	291·78	13·20	...	4·41	...	25·01
30	...	304·98	13·20	...	4·31	...	24·86
31	...	318·18	13·20	...	4·21	...	24·69
Nov. 1	...	331·38		...	4·11	...	24·52

Assumed daily rate of rotation, 14°·20.

MOON.

Libration. Sun's Place. Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* | *Sun's* centre in the zenith.

Terminator. Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.

12h. Greenwich mean time.

1872.	Earth's colong.	lat.	Sun's colong.	lat.	60° N.	0°	60° S.
	°	°	°	°	°	°	°
					Sunrise.		
Oct. 9	92·45	+4·61	4·10	+1·17	96·1	94·1	92·1
10	91·40	5·67	16·28	1·15	108·3	106·3	104·3
11	90·21	6·37	28·45	1·13	120·4	118·5	116·5
12	88·93	6·67	40·61	1·11	132·5	130·6	128·7

13	87·64	+6·55	52·77	+1·09	144·6	142·8	140·9
14	86·43	6·01	64·93	1·07	156·8	154·9	153·1
15	85·40	5·12	77·08	1·05	168·9	167·1	165·3
16	84·67	3·93	89·23	1 02	Sunset.		
17	84 27	2·54	101·37	1·00	9·6	11·4	13·1
18	84·25	+1·04	113·53	0·97	21·8	23·5	25·2
19	84·59	—0·47	125·69	0·95	34·0	35·7	37·3
20	85·26	—1·92	137·85	+0·92	46·2	47·9	49 5
21	86·20	3·25	150·01	0·90	58·4	60·0	61 6
22	87·35	4·41	162·18	0·87	70·7	72·2	73·7
23	88·61	5·37	174·35	0·85	82·9	84·4	85 8
24	89·92	6·10	186·53	0 82	95·1	96·5	98·0
25	91·18	6·56	198·72	0·80	107·3	108·7	110 1
26	92·33	6·71	210·91	0·77	119·5	120·9	122·3
27	93·30	—6·63	223·10	+0·75	131·8	133·1	134·4

Colong. = 90° —λ.

The express object, for which a well marked fundamental point near the middle of the moon's disk is required, is a twofold one.

If a very detailed lunar map on a large scale is to be constructed on really scientific principles, there can be no question but that it must be preceded by and founded upon a correct survey of a great many of the leading points of the moon's disk. Maedler's points of the first order are not only too few and far between, but their accuracy, while perhaps sufficient for his own work, can scarcely be considered great enough for a much enlarged map. Now, in a new undertaking of the kind, instead of following the method adopted by Lohrmann and Maedler, for determining selenographical positions, a far more practical and effective plan (at least in the writer's opinion) will be, to observe the apparent positions of the leading points directly in reference to some common zero-point near the middle of the disk, and to get the selenographical cöordinates of the latter by making it the point of observation in a special investigation of the moon's librations. If by following this plan, the deduction of the cöordinates of the leading points from their observed positions become somewhat more complicated, the observations themselves are made with so much more ease and certainty, and freedom from several sources of error, that the results must needs be of superior accuracy. Now, which is the best zero-point? How does Moesting A (the point O of Schlueter's and Wickmann's observations) or Triesnecker B, or some other point in the neighbourhood, appear in the original negatives of lunar photographs?

The second purpose for which a well-marked point near the middle of the moon's disk is required, is that of being employed in meridional and altazimuth observations of the moon's place in the heavens. The writer does not know how far Maedler's old suggestion has been acted upon in some of the operations of the U. S. Coast Survey, for determining differences of terrestrial longitudes. It is to be hoped that it will be acted upon in the observations for settling the longitudes of the distant stations, where the transit of Venus is to be observed. But which is the best spot for the purpose? When does the shadow within Moesting A cease to be a difficulty, or begin to be one? Instead of asking such questions the writer would prefer to settle them, but he has not had the opportunities for doing so.

The monthly tables for sun and moon are computed with the help of auxiliary tables, which may be published at some convenient occasion before long. The formulæ for libration and others will then probably be found preferable to those hitherto known. In the numbers given above all sensible terms are taken into account.

MINIMA OF ALGOL.

	1872. Oct.	13.	15·4h.	G.M.T.
		16.	12·2	„
Hour and fraction.		19.	9·0	„

The following minor planets come into opposition during October :—

1872.				Mag. m.	A.R. h. m.	P.D. °
Oct. 2	Arethusa	(95)	...	10·5	0 46	68·2
9	Amphitrite	(29)	...	8·8	0 56	80·0
11	Europa	(52)	...	10·5	1 22	92·5
14	Angelina	(64)	...	10·6	1 16	79·8
15	Lactitia	(39)	...	8·2	1 42	92·7
28	Aglaja	(47)	...	11·3	2 15	72·1
28	Artemis	(105)	...	12·7	2 31	91·9
29	Minerva	(93)	...	11·2	2 8	69·8
31	Hecuba	(108)	...	11·9	2 22	71·1

Sweeping Ephemerides for the Comet of Biela, including the Period of Absence of Moonlight in the Morning Sky in October.

1872. 9h. 36m. G.M.T.	Perihelion, Sept. 91·4. R.A. h. m.	Decl. ° ′	Perihelion, Oct. 6·4 R.A. h. m.	Decl. ° ′	Δ	Perihelion, Oct. 14·4 R.A. h. m.	Decl. ° ′
Sept. 28	10 4·0	+6 27	9 43·0	+9 15	1·345	9 20·3	+12 22
30	13·0	5 21	9 52·4	8 6		30·2	11 9
Oct. 2	21·9	4 15	10 1·7	6 56	1·365	40·0	9 56
4	30·7	3 9	10·9	5 46		49·7	8 42
6	39·3	2 4	19·9	4 37	1·388	9 59·2	7 28
8	47·8	+1 0	28·8	3 28		10 8·6	6 15
10	10 56·2	—0 3	37·6	2 20	1·414	17·8	5 2
12	11 4·5	1 4	46·2	1 13		26·9	3 50
14	12·6	2 5	10 54·8	+0 7	1·442	35·8	2 38
16	20·6	3 4	11 3·2	—0 58		44·6	1 27
18	11 28·5	—4 2	11 11·4	—2 2	1·472	10 53·3	+ 0 18

Mr. Bishop's Observatory,
Twickenham : Sept. 17, 1872.

J. R. HIND.

Ancient Eclipses.—Our readers will be glad to hear that Mr. Hind is preparing a work with the details of a long series of calculations on the historical and other eclipses.

We are obliged to postpone our list of subscriptions received, and some interesting articles, for want of space.

Erratum. Page 222, line 6, for *Foxteth* read *Toxteth.*

Book received.—"Eighth Report of the Board of Visitors to the Observatory at Victoria." John Ferres, Melbourne.

TO CORRESPONDENTS.

Notice.—It is particularly requested that all communications be addressed to the Editor, Parnham House, Pembury Road, Clapton.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to John C. Jackson, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 119. NOVEMBER. 1872.

ASTRONOMICAL ALLUSIONS IN HOMER, DANTE, SHAKESPEARE AND MILTON.

By G. J. Walker.

III.—Shakespeare.

Though an acquaintance with law, medicine, divinity, history, politics, geography, and general literature has been ascribed to Shakespeare, we should not expect to find in this greatest of uninspired writers much more in the way of astronomical allusions than images and figures derived from the heavenly bodies. But what Schlegel* remarks of the images in general of Shakespeare, certainly holds good in regard to those of a *celestial* character: that "in their unsought, nay uncapricious singularity, they have a sweetness altogether peculiar." A few passages will be cited at length, and references given to others.

The Moon.—The moon is chiefly alluded to in connexion with her influence on the tides. Thus she is called "watery," Midsummer Night's Dream, act ii., scene 2, King Richard III., act ii., scene 2; "the governess of floods," Midsummer Night's Dream, act ii., scene 2. See also Winter's Tale, act i., scene 2, King Lear, scene v., act 3, 1 Henry IV., act i., scene 2, Hamlet, act i., scene 1. She is the cause of madness :—

"It is the very error of the moon ;
She comes more near the earth than she was wont,
And makes men mad."—Othello act v., scene 2.

And of rheumatic diseases, Midsummer Night's Dream, act ii., scene 2.

The pretty picture of a bright moon-light night will be remembered in the Merchant of Venice :—

"How sweet the moonlight sleeps upon this bank!
Here will we sit, and let the sounds of music
Creep in our ears; soft stillness, and the night
Become the touches of sweet harmony.

* *Lectures on Dramatic Literature.*

Sit, Jessica: Look, how the floor of heaven
Is thick inlaid with patins of bright gold;
There's not the smallest orb which thou behold'st,
But in his motion like an angel sings,
Still quiring to the young-eyed cherubims:
Such harmony is in immortal souls;
But, whilst this muddy vesture of decay
Doth grossly close it in, we cannot hear it."—Act v., scene 1.

STARS.—Cæsar is made to refer to the polar star as an emblem of his own constancy and immovable resolve:—

"But I am constant as the northern star,
Of whose true fix'd and resting quality,
There is no fellow in the firmament.
The skies are painted with unnumber'd sparks,
They are all fire, and everyone doth shine;
But there's but one in all doth hold his place."
Julius Cæsar, act iii., scene 1.

We must not be too critical here; for in the time of Cæsar the pole had moved a long way from κ Draconis, and was still further from reaching our present polar star, the which no doubt Shakespeare had in view; and to which allusion is made again in Othello, in the description of the storm on the coast of Cyprus:—

"The chiding billow seems to pelt the clouds;
The wind-shaked surge, with high and monstrous main,
Seems to cast water on the burning Bear,
And quench the guards of the ever-fixed pole."
—Act ii., scene 1.

Juliet's eyes were brighter than the brightest stars:—

"Two of the fairest stars in all the heaven,
Having some business, do entreat her eyes
To twinkle in their spheres till they return.
What if her eyes were there, they in her head?
The brightness of her cheek would shame those stars,
As daylight doth a lamp; her eye in heaven
Would through the airy region stream so bright,
That birds would sing, and think it were not night."
Romeo and Juliet, act ii., scene 2.

And Juliet says of her lover:—

"Give me my Romeo; and, when he shall die,
Take him and cut him out in little stars,
And he will make the face of heaven so fine,
That all the world shall be in love with night,
And pay no worship to the garish sun.''—Id., act iii., scene 2.

Compare Cymbeline, act v., scene 2..—

————"They are worthy
To inlay heaven with stars."

The stars are called "Diana's waiting women," Troilus and Cressida, act v., scene 2. Their supposed rule over the destinies of individuals is often alluded to: 1 Henry VI., act i., scene 1; 3 Henry VI., act iv., scene 6; King Lear, act iv., scene 3; Romeo and Juliet, act v., scene 3; Julius Cæsar, act i., scene 2; Locrine, act i., scenes 1, 2; act iii., scenes 2, 6; as also are planetary influences: Cymbeline, act v., scene 4.; King Lear, act i., scene 1; Hamlet, act i., scene 1; Othello, act ii., scene 3; Troilus and Cressida, act i., scene 3; Locrine, act i., scene 2; 1 Henry VI., act i., scene 1; 2 Henry VI., act iv., scene 4. But notwithstanding this belief in the influence of stars and planets, which could not

fail to appear frequently in the dramas without of necessity reflecting the poet's own opinion, the latter may perhaps be inferred from such passages as the following: "This is the excellent foppery of the world! that, when we are sick in fortune (often the surfeit of our own behaviour), we make guilty of our disasters, the sun, the moon, and the stars: as if we were villains by necessity, fools by heavenly compulsion; knaves, thieves, and treachers, by spherical predominance; drunkards, liars, and adulterers, by an enforced obedience of planetary influence; and, all that we are evil in, by a divine thrusting on:" . . . The rest of the passage is equally witty, but scarcely suited for public reading now. King Lear, act i., scene 2.

> "Our remedies oft in ourselves do lie,
> Which we ascribe to heaven: the fated sky
> Gives us free scope; only, doth backward pull
> Our slow designs, when we ourselves are dull."
>
> All's well that ends well, act i., scene 1.

Remembering, however, that even Shakespeare's great contemporary Kepler was imbued with the superstition of astrology, it would not be surprising if the poet did not escape it.

Celestial Prodigies.—In Hamlet those preceding the death of Cæsar are thus described:—

> ——"Stars with trains of fire and dews of blood,
> Disasters in the sun; and the moist star,
> Upon whose influence Neptune's empire stands,
> Was sick almost to Doomsday with eclipse."—Act i., scene 1.

See also King Lear, act i., scene 2 (eclipses); Locrine, act v., scene 4.

It may be that a glimpse of Shakespeare's own view appears in the following in King John:—

> "No natural exhalation in the sky
> No scope of nature, no distemper'd day,
> No common wind, no customed event,
> But they will pluck away his natural cause,
> And call them meteors, prodigies, and signs,
> Abortives, presages, and tongues of heaven,
> Plainly denouncing vengeance upon John."
>
> —Act iii., scene 4.

Comets.—Calphurnia, Cæsar's wife, says:—

> "When beggars die, there are no comets seen;
> The heavens themselves blaze forth the death of princes."
>
> Julius Cæsar, act ii., scene 2.

And the Duke of Bedford in the first part of King Henry VI., act i., scene 1, exclaims:—

> "Hung be the heavens with black, yield day to night!
> Comets, importing change of times and states,
> Brandish your crystal tresses in the sky;
> And with them scourge the bad revolting stars,
> That have consented unto Henry's death!"

See also 1 Henry IV., act iii., scene 2.

Venus.—The evening star is allluded to, Sonnet cxxxii.:—

> "Nor that full star that ushers in the even
> Doth half that glory to the sober west,
> As those two mourning eyes become thy face."

Meteors.—Meteors are supposed to be exhalations from the earth; and regarded as portents: "My lord, do you see these meteors? Do you behold these exhalations?" 1 Henry IV., act ii., scene 4; see also

act v., scene 1. Romeo and Juliet, act iii., scene 5. Cardinal Wolsey in prospect of his disgrace, says :—

———"I shall fall
Like a bright exhalation in the evening,
And no man see me more."—Henry VIII., act iii., scene 2.

They are conceived to be drawn from the sky by music :

"And certain stars shot madly from their spheres,
To hear the sea-maid's music."
—Midsummer Night's Dream, act ii., scene 2.

At the destruction of Troy, as it were the mirror of their brightness,

———"The skies were sorry,
And little stars shot from their fixed places,
When their glass fell wherein they viewed their faces."
Rape of Lucrece, towards the end.

See also 1 Henry IV., act i., scene 1 ; Venus and Adonis, stanza 138. The following passages might seem to be grounded on some brilliant display, as of the November meteors in late years. In King John, the Dauphin, Lewis, says of the tears of Salisbury :—

"This shower . . .
. . . Makes me more amazed
Than I had seen the vaulty top of heaven
Figured quite o'er with burning meteors."—Act v. sc. 2.

In the first part of Henry IV., Glendower says :—

———"At my nativity,
The front of heaven was full of fiery shapes,
Of burning cressets * . . .
. . . The heavens were all on fire."—Act iii., scene 1.

In King Richard II.:—

——"Meteors fright the fixed stars of heaven :
The pale-faced moon looks bloody on the earth."—Act ii., scene 4.

Locrine speaks of

"Mighty Jove, the supreme king of heaven,
That guides the concourse of the meteors,
And rules the motion of the azure sky."—Act iv., scene 1.

The last passage to be produced from Shakespeare is from Love's Labour Lost, where Biron speaks thus disparagingly of astronomers :—

"These earthly godfathers of heaven's lights,
That give a name to every fixed star,
Have no more profit of their shining nights,
Than those that walk, and wot not what they are."
—Act i., scene 1.

He may be forgiven this, however, in consideration of the splendid eulogy on women, which he afterwards delivered—a subject on which he was more at home. True it is, nevertheless, that we could have dispensed with some of the work of these modern "godfathers"; and our globes and star-maps would be none the worse for ceasing to exhibit so many memorials of their officiousness and bad taste.

"*SPOTS IN THE SUN.*"

To the Editor of the *Times*.

Sir,—Among the astronomical observations upon record which have not as yet received a satisfactory explanation are those relating to spots upon the sun's disc, which have traversed it much more rapidly than the ordinary solar spots. In several cases these quickly-moving spots are described

* *I.e.* Lights.

as round, black, and sharply defined, like the planet Mercury, in transit, and hence the suspicion has arisen that one or more planetary bodies are revolving round the sun within the orbit of Mercury. M. Le Verrier, from theoretical considerations founded upon an unexplained motion in the line of apsides of this planet's orbit, has inferred the existence of a zone of asteroidal bodies within it.

I have lately examined these observations with the immediate object of ascertaining whether it were possible to obtain a clue, however rough, that might lead to a rediscovery—on the supposition that an unknown planet exists at no great distance from the sun. In more than one instance the observations appear to refer rather to a comet than to a planetary body, and the bright comet of 1819 would seem to have been remarked in its passage over the sun's disc at the end of June by Canon Stark at Augsberg, and probably by Pastorff, near Dresden (though his observation is confused). But, on the other hand, it appears highly improbable that a comet projected upon the sun's disc would present the round, well-defined figure which several observers have noted, and particularly so that it would appear black like the planet Mercury when passing over the sun. It is incredible that so many persons can have been deceived as to the rapid motion of these suspicious objects, and the only conclusion that we can arrive at, unless the observations are altogether rejected (quite an inadmissible proceeding), appears to be that we have not yet brought into harness all the inferior planets that exist.

In the course of my enquiry I have only met with one instance wherein there appears any ground for a prediction which might possibly lead to the recovery of the object to which the observations relate. Small, black, circular, well-defined bodies are reported to have been upon the sun's disc, by Dr. Lescarbault, at Orgeres, in France, on March 26, 1859, and by Mr. Lummis, at Manchester, on March 20, 1862, and it is a suspicious circumstance that the elements as regards the place of the node, or point of intersection of the orbit with the ecliptic, and its inclination thereto, as worked out by M. Valz, of Marseilles, from the data I deduced from a diagram forwarded to me by Mr. Lummis, are strikingly similar to those founded by M. Le Verrier upon the observations, such as they were, of Dr. Lescarbault. It is true if the place of the node and inclination were precisely as given by this astronomer, the object which was seen upon the sun's disc on the 26th of March could not have been projected upon it as early as the 20th of March. But, considering the exceedingly rough nature of the observations upon which he had to rely, perhaps no stress need be placed upon the circumstance. Now the period of revolution assigned by M. Le Verrier from the observations of 1859 was 19·70 days. Taking this as an approximate value of the true period, I find, if we suppose 57 revolutions to have been performed between the observations of Dr. Lescarbault and Mr. Lummis, there would result a period of 19·81 days. On comparing this value with the previous observations in March and in October, when the same object might have transited the sun at the opposite node, it is found to lead to October 9, 1819, as one of the dates when the hypothetical planet should have been in conjunction with the sun. And on this very day Canon Stark has recorded the following notable observation:—"At this time there appeared a black, well-defined nuclear spot, quite circular in form, and as large as Mercury. This spot was no more to be seen at 4.37 p.m., and I found no trace of it later on the 9th, nor on the 12th, when the sun came out again." The exact time of this observation is not mentioned, but appears likely to have been about noon, one of Stark's usual hours for examining the solar disc. Hence I deduce a corrected period of 19·812 days. If such a planetary

body exists, on the supposition that it was remarked upon the sun in 1819, 1859, and 1862, this period would probably not be much in error; and if we suppose the orbit to be circular or nearly so, with the approximate knowledge we have of the place of the node and inclination of the orbit, we may venture upon a prediction of the times of the greatest elongations from the sun eastward and westward, and the positions of the hypothetical body at the times. I have before me places so calculated for the times of the greatest elongations during the next few months, upon which it is proposed to institute a search at this Observatory, using the same means by which we succeeded in bringing out the first comet of 1847 near its perihelion, at noon-day, and less than three degrees from the sun's limb. I refrain, however, from giving publicity to these predictions, in the fear of causing a number of observers to lose much time in searching for a body, which may have no existence except in my own imagination.

I will, nevertheless, suggest that on the 24th of March next a very close watch must be kept upon the sun's disc. With the period I have inferred a conjunction with the sun would occur about 10 a.m. on that day, but it will be desirable to extend the period of observation through the whole 24 hours, and on this account the aid of observers on distant meridians will be important. If the hypothetical body is not found upon the sun's disc at that time, it will be, I think, a sufficient proof that my surmises are incorrect.

In the circumstances I have here described consists the only clue I have been able to discover to a possible recovery of one of these supposed planetary bodies. It is obvious that the object seen upon the sun in March cannot, with its apparent inclination of orbit, be identical with that seen near Midsummer, 1847, in the metropolis by Mr. Scott, the Chamberlain of London, and at Whitby by Mr. Wray, the eminent optician, nor yet that remarked by M. Coumbary at Constantinople in May, 1865. I am, Sir, your obedient servant,

Mr. Bishop's Observatory, Twickenham: J. R. HIND.
October 18.

NOTES ON THE WONDERS AND BEAUTIES OF THE STARRY HEAVENS.

By C. Grover, Assistant to John Browning, Esq., F.R.A.S.

No. 5.—The Annular Nebula in Lyra.

About 6° south of Vega, and a little to the left when on the meridian, are two tolerably bright stars rather more than 2° asunder. The preceding and more elevated star is β, the following one is γ; and, though both are marked third magnitude on the maps of the S.D.U.K., β is a well-known variable, and γ is strongly suspected of the same peculiarity. Of this we may have more to say hereafter; for the present we only refer to them as pointers to an object well-worthy to take rank as one of the most noteworthy of the celestial wonders. A little south of the line joining these two stars, and nearer β than γ, a small telescope enables us to discover a minute roundish nebula. I have thus seen it tolerably well-defined and very like a planetary nebula in a 2-inch achromatic. With a 4½-inch silvered glass speculum the elliptical figure and central opening are distinctly visible, with a 6½-inch speculum it gains in beauty and interest, the faint illumination of the interior and the irregularities of the outer margin are just perceptible. Even with this small aperture

the light is evidently mottled and distinctly different from the milky nebulosity of the great nebulæ in Andromeda and Orion. In the 12¼-inch speculum many details of great interest become visible. The faint nebulosity of the interior is seen to be crossed by four brighter streaks lying in the direction of the longer axis; three of these are about equal in distinctness, but the second streak from the preceding internal edge of the ring is obviously the brightest. When best seen, these details always leave the impression on my mind of being more remote than the ring itself, and this idea is supported by the fact that four or five faint filaments or streams of light are seen extending from both ends of the ellipse as if they were continuations of those within its interior, thus leading to the supposition that the bright ring which is alone visible in small instruments, is seen projected a still more remote, stratified nebulosity; and this opinion is strengthened by the fact that although there are several irregularities about the exterior of the ring's minor axis, they are very faint and unimportant compared with those which appear to traverse the interior and extend beyond either end.

The ring itself when seen with a low power and large aperture exhibits a surprising degree of brilliancy; indeed, when the power is insufficient to reveal the figure of a nebula, it might easily be confounded with some of the tolerably bright stars which appear with it in the same low power field, and with moderate powers its brightness is such, especially about the extremities of the minor axis of the ellipse, as to give a false impression of resolution. Indeed, it has been announced as resolved into stars by several observers of considerable eminence in observational astronomy. These observations, however, are in direct contradiction to the evidence of the spectroscope, which in the hands of an observer worthy of equal confidence, has distinctly shown this object to have a gaseous constitution. Notwithstanding this, I was strongly inclined, from its exceptional brightness and mottled appearance in the smaller instruments I had previously employed, to believe in its stellar composition, and I had great hopes that the power of the 12¼-inch speculum would reveal the "star dust" described by other observers. I have therefore on several occasions, scrutinised the nebula when the absence of the moon, a clear sky, and its position on or near the meridian, allowed it to be seen to great advantage, at such times being steadily kept in view by the equable movement of the equatorial clock, it presented a superb spectacle. But with the utmost care and attention, and the application of considerable magnifying powers, I could never detect the least indications of a stellar composition, it simply appeared as nebulous as ever. I do not percieve with this aperture any appearance of the fluctuation of light or twinkling appearance which has been described by some observers, and which would seem to be caused by insufficient optical power, as I have sometimes noticed an unsteady appearance when using a small speculum; an analagous phenomenon is perceived when observing a star so minute as to be only just within the power of the aperture in use, which will appear fluctuating or seen by glimpses. With this every observer is familiar.

A small star follows the nebula on an angle of 96°, and at a distance of rather more than the breadth of the ring as determined by Sir J. Herschel, he gives it eleventh magnitude, but it appears to me, as it does to several observers, much smaller. I find it but just steadily visible in a 6½-inch speculum. This star, which is shown in most of the copies of Sir John's drawing to be found in every recent astronomical work, has been suggested as a convenient fixed point from which to obtain a set of micrometrical measures of the internal and external dimensions and

positions of the centre of the nebula, so as to afford a ready means of detecting any changes of form, size, or position, which might hereafter take place. This very desirable information is not, however, so easy to be obtained, many serious practical obstacles standing in the way of its accomplishment. For instance, the small instruments which give the best outline of the nebula scarcely show the star, and with larger apertures the star is of course well seen, but the outline of the nebula becomes more and more irregular with increasing powers, and again the illumination of the field necessary to render the micrometer webs visible seriously interferes with the distinct perception of so delicate an object. There are four other much smaller stars nearer the nebula than the one just mentioned, one of these lies at a rather less distance from the opposite edge of the ring, two others forming a neat pair are very near its northern margin, and another about as near the southern edge; these very delicate objects are visible with a power of 300 on the $12\frac{1}{4}$-inch speculum.

The Annular Nebula in Lyra is by far the largest and most conspicuous representative of this not very numerous class of objects. Two other examples, figured by Sir John Herschel in his "Cape Observations," are well worthy of notice as exhibiting the different appearances we might expect in such objects, arising either from increased distance smaller dimensions, or inferior optical power. One of these is situated is R. A., 17h. 19m., and 23° 37′ south declination, and is therefore a little north of the centre of a line joining the two fifth-magnitude stars 44 and 50 in Ophiuchus. It is described as "exactly round, pretty faint, 12″ in diameter, well terminated, very little cottony at the edge, with a decided darkness in the middle, few stars in the field, a beautiful specimen of the planetary annular class of nebulæ." Any observer who has seen the nebula in Lyra with a small telescope, will at once perceive that, as regards the general appearance, this is an exact description of that object. The other example has R. A., 17h. 10m., and south declination, 38° 18′, and therefore only barely rises above our horizon; it is described as "a delicate, extremely faint, but perfectly well-defined annulus, 15′ 20″ diameter, the field crowded with stars, two of which are on the nebula." These stars are shown in the figure at the opposite sides of the minor axis, and therefore coincide with the brightest parts of the ring of the nebula in Lyra. "The interior, indeed, appears to be devoid of any illumination, but the object is so faint that a nebulosity filling in the centre and bearing no greater proportion in respect of density to the ring, than in the case of 57 M., could not be perceived."

It is worthy of remark, as showing how little many book illustrations resemble the objects intended, that in "Guillemin's Heavens," 2nd edition, page 335, both these objects are engraved, the former with a perfectly black centre, and the latter with an interior distinctly nebulous, in direct contradiction to the figures and descriptions of Sir John Herschel.

In the "Cape Observations," he remarks, "it is not impossible that the real constitution of these bodies may be that of hollow spherical or elliptical shells, of which the borders appear brighter than the interior by reason of the greater thickness of the luminous matter, or starry stratum, traversed by the visual ray." The tenuity of the ring, as well as the feebleness of the central illumination, will of course in our hypothesis be proportioned to the thinness of the shell; and the law of the degradation of its light will be determined by the ratio of the radii of its inner and outer surfaces, as well as by the law of density of the strata of which it consists.

The thoughtful reader will not be slow to perceive that, though this hypothesis perfectly explains the regular outline of the nebula in Lyra as seen in the 18-inch reflector, the streaks in its interior, and the numerous filaments extending from its circumference more recently observed, point to a more complicated constitution, and render this hypothesis somewhat unsatisfactory. Moreover, it is not improbable that a re-examination of other objects of this class with superior optical means, may lead, as we have seen to be the case with other nebulæ, to very different views of their constitution to those now entertained.

ASTRONOMY IN CENTRAL ASIA.

That a considerable amount of astronomical knowledge may be, and has been, acquired by different tribes living in Central Asia is generally admitted; and Col. Chesney has given a curious account, extracted from a work published at Paris in 1840, of a primitive people of the present day, who wander with their flocks over the vast steppes of Central Asia. The Kioghis-Kazak tribe have preserved a certain knowledge of astronomy, handing it down from father to son. Living in the open air, under the shade of a rock, a cave, or a tent, they watch the motion of the sun by day, and the revolution of the heavens by night. Like the earliest Chaldeans and Egyptians, they have no other means of measuring time than those afforded by the sun, moon, and stars; and they distribute their days by the sun, as a European does by his watch. Like their prototypes, the Chaldeans, they, too, have a system of astrology, in accordance with the rude principles of which they people the heavens with good and evil spirits, who preside over the days of the year, and to whose influence they suppose all living things to be subject. The names of the constellations have a curious connection with the wants and habits of the people themselves. Thus they call the North Pole, which, as the directing point, occupies the first place in their heavens, the iron stake; Venus bears that of "The Shepherd," as rising when the cattle are brought home or taken out to pasture; the Great Bear they compare to seven wolves following a grey and white gelding; the Pleiades to wild sheep, and when absent, supposed to be bringing grass to the terrestrial sheep; and the Milky-way is called the road of the birds emigrating from north to south. (Alexis de Leochine: *Description des Hordes, etc., Kioghis-Kazaks trad. du Russe, Paris,* 1840).

Vaux: *Nineveh and Persepolis*, pp. 51, 52.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

TESTS FOR THE TELESCOPE.

Sir,—Many amateurs of small experience conclude, unreasonably, that their telescopes are at fault, because they cannot make out the tests mentioned in books. Their instruments may, however, be excellent, but their vision not as yet sufficiently trained for that kind of work. It is a well-known fact that the eye is susceptible of education, and that practice will render visible faint objects whose very existence could not at first be

as much as suspected. Many who do not perceive a minute star, after a few minutes of searching, give up further observation, and blame the telescope; but if they had persevered a little longer they would, in many cases, have been rewarded with success. It is essentially necessary to be in an easy position when using the telescope, for if the head and arms be shaking one need not expect to see any difficult object. The powers of vision are very different with different persons. Kepler informs us that his pupil Möstlin could perceive fourteen stars in the Pleiades, and a daughter of the present Astronomer-royal can see twelve in the same group. They are few in number who with the unassisted eye can see more than six. So it is with the telescope. One observer looking through a telescope will be able to see certain objects, and another looking through the same instrument, under similar circumstances of definition and atmosphere will not be able to perceive them. There are renowned observers, such as the late Mr. Dawes, in whose hands a small instrument was as efficient as a larger one in the hands of others. They published their success, and proposed tests to prove the merits of a telescope. These sharp-sighted observers were like eagles among astronomers, and the tests proposed by them might do very well if all telescopists were gifted with similar powers of vision. Dawes saw the companion to Polaris distinctly and steadily with an aperture of 1·6, and proposed that star as a test for a telescope of 2-inches. I think that those who see it with that aperture are not very numerous, and that it will require one of about 3-inches for a person of ordinary sight. When amateurs are trying their telescopes, they should remember that what astronomers call personal equation plays a very important part, and that they are apt to blame a good telescope for the peculiarities of their own vision. Some eyes are more sensitive to certain colours than to others, and some eyes are more easily dazzled by the light of large stars than others, in such a way that they cannot see minute points of light in their vicinity. Webb proposes the Comes to Polaris, as a test for small apertures above 2-inches, and in speaking of his $3\frac{7}{10}$ achromatic, he asserts that all it can do is to glimpse the companious of Vega and Aldebaran, Now, I have a telescope in which the visibility of these small stars is astonishingly easy, but with which I experience some difficulty in seeing the small speck of light near Polaris, and I suppose that is owing either to the peculiarity of its hue or to its variability, although I have not read anywhere that it is changeable. Another common but very improper test is the trapezium in Orion, as it is scarcely sufficiently high to clear the mists of the horizon. The sixth star may at one time be visible in a telescope, and at another be invisible in one of far greater power. Dawes says that it is decidedly variable to the extent of at least one magnitude of Struve's scale. If this be so, it has at its minimum scarcely one-fourth of its light at the maximum, Such an object is evidently a very bad test for the telescope. No variable star, nor binary whose components are constantly changing their relative positions, ought to be adopted as test objects; because after the lapse of a certain time they are either more easy or more difficult. Some test their instruments on the planets, and condemn them unless they perceive the features they have read of in astronomical books, or seen in pictures. Now, an instrument may be an excellent one, and not exhibit these features. Even Dawes, using the best instruments manufactured by Clarke and Cooke, could never make out any markings on Venus, whereas Mr. Holden, of London, saw them very distinctly with an ordinary 3-inch achromatic. Again, as is mentioned in the *Astronomical Register* for 1865, that Dawes and Barneby, using achromatics of $8\frac{1}{4}$ and 9-inches, could not see a penumbra to the shadow of any of the satellites of Jupiter when

they were in transit, whereas Gorton with a $3\frac{7}{8}$-inch achromatic easily perceived that phenomenon, which he compared to the penumbra of a solar spot. If beginners attended to these matters they would be less inclined to blame their telescopes and the opticians who manufactured them.

I am, sir, yours,

J. S.

ON THE MINOR PLANETS.

Dear Sir,—To enable me to state clearly what I wish to advance about the minor planets, you must kindly allow me to say a few words concerning the other members of the solar system. For many years I looked on the primary planets, when only eleven were known to us (from Mercury to Uranus), as all forming only *one* great class of heavenly bodies. The years 1845, 1846, and 1847, increased the number to sixteen, and called especial attention to the planetary worlds. The new minor planets taught us to examine the specialites of the planets generally. The major planets, with their new companion Neptune, presented their mighty orbs to us with peculiarities, in which they differed from all the others, and appeared, with their days of ten hours, as a distinct class. The four next the sun (our old friends), then exhibited their peculiarities, which they all had, and by which they were distinguished from all the other planets, thus establishing a claim to be considered a group in themselves, having their days of 24 hours. Though thus in separate groups, they were all *planets* moving under planetary laws round the great central sun. They also had in their differences a striking similitude—see their diameters bearing the same proportion to each other — here the earth 8,000, there Jupiter above 80,000; here Venus upwards of 7,000, there Saturn upwards of 70,000; here Mars 4,000, there Neptune 40,000, nearly; here Mercury 3,000, there Uranus a little more than 30,000; the inner group showing 3,000, 4,000, 7,000, and 8,000, nearly; the major planets very close on 30,000, 40,000, 70,000, and 80,000. When we look on them as being two separate and distinct families of planets we recognise no necessity for one planet between them to complete a system. Bode's law (that of Bonnet or of Titius rather), is interesting, but it is empirical—*i.e.*, a quack law, and proves nothing. As to the vast chasm between Mars and Jupiter, it cannot be considered so great as often represented when we calculate the much vaster intervals between the four major planets. When we are satisfied that we have, in the solar system, two distinct groups formed by the above, we may turn to the consideration of

THE MINOR PLANETS.

Here I contend we have a third group, being like the other two *sui generis*, yet obeying the same laws, and to all intents and purposes not planetoids, but perfect and complete planets. They chiefly differ from the planets of the other groups, in their great numbers, and in their comparatively small magnitudes; the former flows naturally from the latter, and both peculiarities should intensify our interest in their discovery. Let no one call them *chips* and *bits*, or even by the more respectable term *fragments*. What might a Jovian say of our earth? At a meeting of their R.A.S., held on the planet Jupiter, which is one thousand times greater than our little residence, how easily could he prove that animal life could not be supported on such a diminutive little spot. A man who ever had a look through a microscope should not speak so.

But regarding the diameters of these minor planets, perhaps we shall find, that they are all right and just what they should be. Very high authorities say that the smaller ones are from 300 miles in diameter, and

that the larger ones are under 1,000 miles, what do these measurements tell us, but that they are in magnitude to those of our group as ours are to the greater planets. Let us not be surprised at this proportion appearing here, for we find that it goes on higher as well as lower. Jupiter's diameter may be, to the very mile, one-tenth of the diameter of the centre of the system—of the sun himself. As to their being so numerous, I shall not say what I think, lest some of our computers would come down upon me for attempting to disturb Mars in his orbit (see *Le Verrier's* paper in Monthly Notices xiv. 62.) I must now conclude, not for want of more to say, but because I am unwilling to take up more of your valuable pages. Before I do so, allow me to state what Sir John Herschel said concerning the fragmentary theory:—"This may serve as a specimen of the dreams in which astronomers, like other speculators, occasionally and harmlessly indulge."

These minor planets, on which many pages used to be written, in all astronomical periodicals, are now much disregarded; yet they move on each in its appointed bright path in the starry firmament exemplifying Addison's beautiful lines—

"For ever singing as they shine,
The hand that made us is divine."

They manifest, in my opinion, so much of life and beauty that the fragmentary theory seems to me, like a proposal that we should look on the beauteous humming birds, not as real birds, but as fragments of some bird of Paradise blown to atoms.

Dear Mr. Editor, bear with your aged friend,

Angela Gardens, October 18th, 1872. SENEX.

P.S.—That I have a right to sign my letter as I have done, will appear when I tell you that I lately gave an eminent astronomer an account of the exact appearance in Ursa Major, of the comet of 1811, which comet I remember better than those of 1861.

THE NEBULA IN PLEIADES.

It would appear that Mr. Grover considers that this nebula has probably not changed for thousands of years, *because* it was singularly variable a few years ago. One fails to see the force of this reasoning.

He admits that the nebula has been seen with very moderate telescopic power, and he equally admits that he has lately found it a very difficult object with very considerable telescopic power. The inference would seem to be that it has varied. But, "No," says Mr. Grover; for, years years ago, it was more than once found to be a difficult object with very powerful telescopes. What does this prove, except that years ago the nebula was varying?

How a nebula can be at one time an easy object, and at another (no matter whether the next week, or the next year, or the next century), a very difficult one, and yet not be variable, is the problem Mr. Grover has to solve. I fancy it will "take him all his time," after the manner of speaking.

FACTS RATHER THAN FANCY.

NEW RED STAR.

Sir,—In No. 1902 of the *Astronomische Nachrichten*, Mr. J. F. Julius Schmidt, the astronomer of the Observatory at Athens, says, that on the 18th of July of the present year, he discovered a star, the glowing fiery-red

colour of which is more strongly marked than in *μ Cephei*, or in R *Leporis*.

The following is the position of this star as given by Mr. Schmidt:—

R.A.	Declination.	Magnitude.
18h. 56m. 56s.	South 5° 53′·4	7·8

Mr. Schmidt remarks, that though the star in question was observed both by La Lande and by Bessel, neither of them notices its peculiar colour; he, moreover, states that this star is not inserted in the list of coloured stars published either by Secchi or by Schjellerup.—I am, sir, yours truly, W. G. LETTSOM.

Lower Norwood: 23rd Sept., 1872.

CONNECTION OF METEOROLOGY AED ASTRONOMY.

Sir,—Before proceeding to other records, permit me to make a few remarks on the records of storms and rainfall in the September *Register*.

The number of storms per year at Toronto (average of 20 years) has been 33. But at the sun-spot max. of 1860, the number was more than doubled, three years giving 240 storms, or 74 per year. Again, the sun-spots reached their maximum late in 1870, or early in 1871, I think the latter, for the five years previous we had an average of only 19 storms, whilst last year we had 63 occasions in which the wind moved more than 30 miles per hour, and storms are very numerous at present. But the storms commenced a year before the sun-spots reached their max. in 1860, and this storm period does not appear to have begun before the max. of sun-spots. This seems to show that solar energy is not the direct cause of storms, but that some common cause may affect both earth and sun.*

In relation to the record of rainfall, I wish to observe, that the curve formed by the numbers does not run parallel with the curve of sun-spots; the rain curve at Toronto at the first glance seems to be very irregular; but a little examination shows that there have been two depressions between each max. and min. of sun-spots, and one large wave between the min. and max.

We look a little closer and we find, 1st, that the driest years have been at the maximum and minimum years of spots; 2nd, that the wettest years have been the years preceding the dry years; 3rd, that the amount of the dry year's rainfall, added to the year which preceded and the one which followed it, gives the sum of 85 inches.

The dry year at sun-spot max. or min. is near 20 inches, the wet one preceding usually about 34, but this is liable to some trifling variation.

Those facts were noticed in 1870, and the rainfall was predicted in the *Toronto Leader*, 33 in. for 1870, 22in. for 1871, and 27in. for 1872. The two which have passed have been correct to the fraction of an inch, and from present appearances the present year will be correct also.

I think it worthy of note that the number of waves in our rain curve is the same as the waves in the temperature curve at Edinburgh, as found in the report of the Astronomer Royal for Scotland, 1871, and that report shows a low temperature at both sun-spot max. and min., much in the same manner as we find a dry period at max. and min. of sun-spots at Toronto.

* I am glad to see that W. de la Rue, President of the Physical Section of the British Association called attention to this subject at the last meeting of that body. Mr. Meldrum's observations on cyclones and the sun-spot period, seem to me very important. The writer, however, called attention to this connection, and predicted the present storm-period in the *Toronto Leader* more than a year ago.

And in this connection I would remark that the record of rainfall kept at Marrietta in Ohio, coincides closely with the Toronto record. The curve in both cases show a depression on dry weather at max. and min. of sun-spots, and this record extends back to 1826.

The valuable tables lately published by the Smithsonian Institution, under the direction of Prof. Henery, will, when fully examined, doubtless throw much light on this interesting question.

TORONTO TEMPERATURE TABLE.

Year.	Mean Temper.	Year.	Mean Temper.
1840	43·6	1856	42·2
1841	43·9	1857	42·8
1842	44·0	1858	44·8
1843	42·4	1859	44·2
1844	44·5	1860	44·3
1845	44·6	1861	44·2
1846	46·4	1862	44·4
1847	43·7	1863	44·6
1848	45·1	1864	44·7
1849	44·1	1865	44·9
1850	44·4	1866	43·5
1851	44·6	1867	43·8
1852	43·8	1868	43·3
1853	44·8	1869	43·1
1854	45·2	1870	45·9
1855	44·0	1871	46·0 ?*

The foregoing table shows a decided low temperature at every minimum of sun-spots.

I remain, truly yours,

A. ELVINS.

P.S.—In reply to the remark of "Observer" in the August *Register*, I wish to say that my observation in the *Toronto Telegraph* in 1870, was rather the conclusion of others than my own (Lardner was my chief authority). At present I think it quite likely that planetary positions must have more or less to do with weather; indirectly, however, I shall be glad to follow this subject with "Observer" at some future time. I would be much pleased if he would send me his address.—A.E.

NEW DOUBLE STAR NEAR 43, *DELPHINI.*

About two weeks since I had the pleasure of using for one evening Prof. Young's magnificent Alvan Clark Refractor of 9·4 in. aperture, at the Dartmouth College Observatory; and, although the night was a very poor one, I found one close double star worthy of note. About 25′, almost exactly north of that fine pair, 43 Delphini (Σ 2723), will be seen a wide pair of 8½ m. stars about 100″ apart. The north star of this pair is the one in question. The components are nearly equal, and the distance estimated at 0″·7. It is a very difficult object with my instrument of 6 in. aperture, and the very best weather is necessary in order to see it well. This star is Weisse XX., 977, and its place for 1870:—R.A., 20h. 38m. 49s.; Dec. 12° 15′.

* There may be a fraction of error in the last year, as in this case I trust to memory not having the record at hand.

There are two very faint companions to 43 Delphini, *n p*, the three being in a line, and the nearest some 20″, or 30″ distant from the primary. The brightest of the two I had detected with my own instrument last year, but the other is still more minute, and I think beyond the reach of a 6-inch. Neither of these faint stars are mentioned in any of the catalogues.

Chicago: September 10. E. W. BURNHAM.

DISCOVERY OF THE PLANET VESTA.

Sir,—I see by M. Arago's "Popular Lectures on Astronomy" (translated with notes, by W. K. Kelly, B.A., 1854), that the planet Vesta was discovered by a *pupil* of Olbers, and not actually by this astronomer himself, as I have always imagined. Surely if this is the case some credit is due to the pupil, though the discovery may have been made through the instrumentality of Olbers. I shall be glad if any of your readers can give me any information on this matter.

I am, Sir, your obedient servant,

October 17, 1872. J. S. G.

NEW DOUBLE STARS.

Sir,—I beg to call attention to three close and interesting double stars discovered within the last week with my 6-inch Alvan Clark Refractor.

Aquarius.—This pair is in the same low power field, with 60 Aquarii, 12′ 39″ exactly south. The magnitudes are about 8½ and 9½, D=2″, P=210°. A 13 m. star 20″ or 30″ from the primary *s p* makes it triple. By some oversight 60 Aquarii is not shown on Proctor's Atlas. It is the first star visible to the naked eye south of η Aquarii, the two being about 1½° apart. The place (1870) of this triple is as follows:—R.A., 20h. 38 m. 49 s.; Dec. S 12° 15′.

Pisces.—This very beautiful pair is 1m. 30s. *p* 7 Piscium, and is the brightest of four stars in the same field, forming a small trapezium. The distance will not much exceed 1″, the magnitudes being 8½ and 9 or 9½. This is is an elegant object, and a rather difficult one with a small aperture. This star is Weisse XXIII., 229. R.A., 23h. 12m. 12s.; Dec. N. 4° 42′.

Sagittarius.—A very close and nearly equal pair, 13′ north of *o* Sagittarii. The distance I estimate at 0″·8. From its small elevation it is a very difficult pair. This star is B. A. C. 6,504, and is rated as 8m. in that catalogue; but it seems at least half a magnitude brighter. Its place is R.A. 18h. 56m. 33s.; Dec. S. 22° 1′.

A few weeks ago I forwarded a note in reference to two new double stars in Sagitta, but at that time could not give the catalogue position. The first and closer of the two pairs is Lalande, 38,415 7m. R.A., 19h. 59m. 27s. Dec. N. 15° 8′. This is rated by Argelander (+15° No. 4,040) as of the 6m. The second double star is Weisse XIX., 2,025, 8m., rated by Argelander (+15° No. 4,047) as 7m. If any observer is able to see the first well with an aperture much below 6-inches I should be glad to see it stated. All the places are for 1870.

I have now originals or copies of all the double star catalogues and lists heretofore published, so far as I am aware, and none of them embrace any of the doubles in question. In the *Astronomical Register* for August brief mention was made of 12 Scorpii, which star I now find is in Herschel's "Cape of Good Hope Observations," a work at that time I had never seen.

Chicago: September 12. S. W. BURNHAM.

NEW DOUBLE STARS.

Dear Sir,—I have been very much interested by Mr. Burnham's letter in the last number of the *Register*. That he should have been able, with his aperture of 6 inches to see so delicate a star as his X, speaks volumes for the great excellence both of his eye and his instrument. I cannot find this star (X) in any of my double-star catalogues, and I think it will prove to be hitherto unknown.

Mr. Burnham's other star (Y) seems to me very evidently No. 2629 of Struve's Dorpat catalogue (1827). This catalogue, it is well known, is the foundation of the Mensuræ Micrometricæ. No. 2629 is thus described—

R.A. 19h. 59·5m., Dec. + 15° 35′ (Epoch 1826) IV. (8) (10).

The Roman numeral IV. refers to Sir William Herschell's class IV., of stars between 16″ and 32″ distance. This is wider than Mr. Burnham's estimation, but it should be borne in mind that in the case of these very delicate stars, the most experienced observers are frequently at fault in estimations of distance. No. 2629 is one of the *rejectæ* of the Mensuræ Micrometricæ, rejected because "the Comes is less than the ninth magnitude."

The pair F of Mr. Burnham's map is evidently No. 397 of Struve's Poulkova catalogue of double and multiple stars (1843), generally quoted as Otto Struve's. It is described as follows for Epoch 1840:—

R.A. 19h. 57m. 26s. Dec. + 15° 27′ (7·8) (8) mag. Cl. IV.

This Class IV. is again the same as Sir W. Herschel's, comprising stars of which the distance is from 16″ to 32″.

I have been interested by comparing Mr. Burnham's map with Argelander's wonderful charts. I think I can identify all Mr. B.'s stars with those in Argelander's map, which, however, contains many additional stars not shown in Mr. Burnham's delineation. The stars F, X, and Y, seem to be respectively the stars No. 4,038, 4,040, and 4,047, of Argelander's zone + 15°, though Argelander's magnitudes are greater than those assigned by Mr. Burnham, possibly from a different scale being employed. Bad weather and other unavoidable impediments have hitherto prevented my examining this interesting group with my 8-inch equatorial.

Yours truly,

GEORGE HUNT.

Chad Road, Edgbaston, Birmingham :
October 11, 1872.

STARS ON MOON'S DISC IN OCCULTATIONS.

Sir,—The projection of a star on the disc of the moon in an occultation, is a phenomenon, the cause of which is so little understood, that all careful observations of it should be recorded in the hope that a fair explanation may be ultimately obtained.

On September 24th, 1872, I observed the occultation of ϵ Geminorum, with an $8\frac{1}{2}$ inch silvered glass reflector, by Browning, of excellent definition, the power used being an achromatic eyepiece of 144. The atmosphere was very clear, and free from cloud or haze.

The star approached the moon flashing a good deal, and of a decidedly yellow colour, almost orange. The bright limb of the moon, on account of the low attitude, was not steadily and sharply defined, but boiling a little. On the star coming in contact with the apparent limb of the moon it gradually diminished in brightness, lost all its flashing and its yellow colour, and encroached on the surface of the moon as a round white disc like a little planet cleanly defined. The star had passed *through* the

rather boiling edge of the moon and appeared on the even surface of the moon's disc before it disappeared. The time from the moment it began to diminish in brightness till it disappeared was about four seconds. On disappearing, the little white disc, which had no stellar character at all about it, seemed to hang or pause for an instant and then vanished.

The re-appearance of ϵ Geminorum and its 9.5 magnitude comes was satisfactorily observed about 1h. 0m. 30s. after disappearance. It "started into light" as yellow and flashing, nearly as much as when first observed prior to occultation.

The Astronomer Royal's explanation of such phenomena, as quoted from the "Memoirs of the Astronomical Society" in Lardner's handbook, seems to account for the star diminishing in brightness, but it hardly explains the change of colour observed. Admiral Smyth (Cycle vol. ii. p. 103), reports an observation of the projection of Aldebaran on the moon's disc, but makes no mention of diminution of light or change of colour. He says:—"I saw Aldebaran approach the bright limb of the moon very steadily; but from the haze no alteration in the redness of its colour was perceptible. It kept the same steady line to about three-quarters of a minute inside the lunar disc, where it remained as precisely as I could estimate 2½ seconds, when it suddenly vanished."

At the meeting of the Royal Astronomical Society, January 11th, 1867, it was stated that—"Mr. Airy remarked at the occultation of Aldebaran the star did not come out bright instantaneously but was 38 seconds regaining its full light."

This, I presume, refers to the occultation of Aldebaran, on November 22nd, 1866, when the star reappeared about 12½ hours after full moon, and so close therefore to the bright terminator of the moon, that possibly under the Astronomer Royal's explanation referred to above, the retardation of the star's regaining its full light might be due to the same effects of irradiation which produced the diminution in the light of ϵ Geminorum I noticed.

This phenomenon appears to have been frequently observed with Aldebaran, but I cannot ascertain that it has been ever noticed in occultations of stars of the third magnitude, though I cannot doubt that observers, using powerful telescopes, have often found it to be the case.

Stormy weather unfortunately prevented me observing the occultation of κ Geminorum on the 25th. I trust if any of your readers witnessed either of these occultations they will favour you with their results.

I am, Sir.
Your obedient servant,
E. B. KNOBEL.

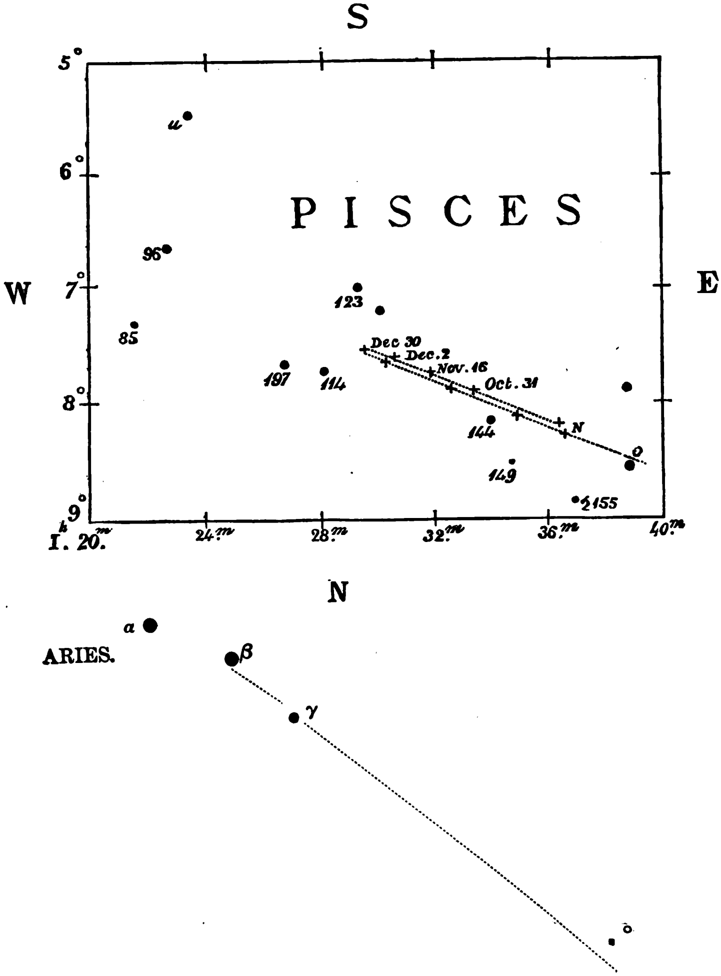
Burton-on-Trent,
Sept. 26th, 1872.

P.S.—I should add that the atmosphere was so clear that the re-appearance of ϵ Geminorum would have been visible without a telescope. The instant after it appeared I had no difficulty at all in seeing it with the naked eye.

It may not be generally known that amongst other works translated of late years into the Chinese language are the following:—Herschel's *Outlines of Astronomy*, by Wylie, 3 vols., sm. folio, China, 1859; De Morgan's *Algebra*, by the same, 8vo, 1859; Mac Gowan's *Law of Storms*, China, 1853; Milner's *History of England*, abridged, by Muirhead, Shanghai, 1856. There is also a Treatise on Arithmetic, in Chinese, by Wylie, 1853.—See Bernard Quaritch's "Catalogue of Oriental Literature, &c.," Sept., 1872.

PATH OF NEPTUNE (N.).

From October 3rd, 1872, to April 15th, 1873 (inverted view).



A line joining β and γ Arietis, prolonged downwards to a distance from γ equal to ten degrees, or less than twice the distance between α and γ, passes to the left of *o* Piscium, fifth mag. Having found this star, the diagram will readily enable Neptune to be identified. He appears about the same size as the star 149, eighth mag. In the beginning of 1873, the

planet commences a direct movement a little to the N, of its previous path. Its places are marked for January 29, February 26, March 18 and 30, and April 15; on April 14 it will be about 2¾′ below *o* Piscium.

Two other objects marked in the diagram are well worth looking at, Σ 155 and 123, close double stars. See Webb's "Celestial Objects," &c.

GEORGE J. WALKER.

QUERY. DOUBLE STARS.—What are the best authorities on the double stars south of the equator (I mean south declination), and where are the catalogues, if any, published? I have Sir John Herschel's "Cape observations."—M. J.

THE PLANETS FOR NOVEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m
Mercury ...	1st	15 13 35	—19 11½	4″·8	0 29·2
	15th	16 39 45	—24 30½	5″·4	1 0·1
Venus ...	1st	16 23 13	—22 32	11″·6	1 38·6
	15th	17 37 58	—24 50	12″·2	1 58·1
Jupiter ...	1st	10 3 34	+12 46	33″·2	19 16·1
	15th	10 9 35	+12 16	34″·5	18 27·1
Saturn ...	1st	19 10 17	—22 25	14″·4	4 25·1
Neptune ..	4th	1 33 3	+ 7 49		10 35·2
	16th	1 31 56	+ 7 43		9 46·9

Mercury sets about twenty minutes after the sun at the beginning of the month; the interval increasing to an hour at its end.

Venus is getting into a good position for observation. Towards the end of the month she sets about two hours after the sun.

Jupiter rises after sunset after the 4th, and may be observed for the rest of the night.

Neptune is well situated for observation.

MINIMA OF ALGOL—According to Schöenfeld.

1872.	Nov. 2.	17·1h.	G.M.T.	Dec. 1	9·2
	5.	13·9		4.	6·1
	8.	10·7		15.	17·3
	11.	7·5		18.	14·2
	25.	15·6		21.	11·0
	28.	12·4		24.	7·8

ASTRONOMICAL OCCURRENCES FOR NOVEMBER, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. α Pegasi
Fri	1	 10 8 15 20	Sidereal Time at Mean Noon, 14h. 44m. 19·12s. Conjunction of Mars and σ Leonis (2·1m.), E. Conjunction of Moon and Mercury 2° 25′ S.	1st Tr. I. 3rd Sh. I. 1st Sh. E. 1st Tr. E. 3rd Sh. E.	13 44 13 55 14 52 16 4 17 38	— 8 12·7
Sat	2	23 39	Conjunction of Moon and Venus, 0° 25′ S.	1st Oc. R.	13 23	8 8·8
Sun	3					8 4·9
Mon	4		Sun's Meridian Passage, 16m. 17·72s. before Mean Noon	4th Oc. D.	17 47	8 0·9
Tues	5	13 5	Conjunction of Moon and Saturn 3° 38′ N.	2nd Sh. I.	16 39	7 57·1
Wed	6	7 38	Conjunction of Jupiter and α Leonis (4·2m.), W.			7 53·1
Thur	7	15 51 9 45	☽ Moon's First Quarter Conjunction of Mercury and δ Scorpii 0° 12′ S.	2nd Oc. R. 1st Ec. D.	16 20 17 18 13	Moon. — 5 47·0
Fri	8			1st Sh. I. 1st Tr. I. 1st Sh. E. 3rd Sh. I. 1st Tr. E.	14 25 15 39 16 46 17 53 17 59	6 42·9
Sat	9					7 35·3
Sun	10					8 24·7
Mon	11					9 12·3
Tues	12		Saturn's Ring: Major Axis=35″·63 Minor Axis=14″·66	3rd Oc. D. 4th Sh. I. 3rd Oc. R. 4th Sh. E. 2nd Sh. I.	13 5 13 44 16 47 18 40 19 12	9 59·2
Wed	13	7 33 8 34 16 10 17 2	Occultation of B.A.C. 728 (6½) Reappearance of ditto Occultation of 31 Arietis (6) Reappearance of ditto			10 46·4
Thur	14	17 8 19 5	○ Full Moon Eclipse of the Moon Occultation of B.A.C. 1096 (5½)	2nd Ec. D. 2nd Oc. R. 1st Ec. D.	13 32 18 18 58 19 11 17	11 34·7
Fri	15	 15 16 16 27	Illuminated portion of disc of Venus = 0·853 Illuminated portion of disc of Mars = 0·913 Occultation of 53 Tauri (6) Reappearance of ditto	1st Sh. I. 1st Tr. I. 1st Sh. E.	16 19 17 34 18 39	12 24·7

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	16		Sidereal Time at Mean Noon, 15h. 43m. 27·46s.	2nd Sh. E. 1st Ec. D. 2nd Tr. E. 1st Oc. R.	11 24 13 39 35 13 57 17 12	Moon. — 13 16·1
Sun	17	6 7	Sun's Meridian Passage, 14m. 47·14s. before Mean Noon Occultation reappearance of 132 Tauri ($5\frac{1}{2}$)	1st Tr. I. 1st Sh. E. 1st Tr. E.	12 3 13 8 14 23	α Pegasi — 7 9·8
Mon	18	6 17	Occultation reappearance of ε Geminorum ($3\frac{1}{2}$)	1st Oc. R.	11 41	7 5·9
Tues	19	8 49	Near approach of κ Geminorum ($3\frac{1}{2}$)	3rd Ec. D. 3rd Ec. R. 3rd Oc. D.	12 4 23 15 38 15 17 6	7 ·9
Wed	20	7 31 12 19	Conjunction of Mars and β Virginis 9·2m. W. Conjunction of Moon and Uranus 4° 10′ S.			6 58·0
Thur	21			4th Oc. D. 2nd Ec. D. 4th Oc. R.	12 11 16 7 53 17 2	6 54·1
Fri	22	17 45 12 55 18 37	☾ Moon's Last Quarter Conjunction of Moon and Jupiter, 4° 42′ S. Near approach of B.A.C. 3579 (6)	1st Sh. I. 1st Tr. I.	18 12 19 28	6 50·1
Sat	23			2nd Sh. I. 2nd Tr. I. 2nd Sh. E. 1st Ec. D. 2nd Tr. E. 1st Oc. R.	11 2 13 37 13 58 15 32 36 16 31 19 6	6 46·2
Sun	24			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	12 41 13 56 15 1 16 16	6 42·3
Mon	25	0 5	Conjunction of Moon and Mars, 3° 26′ S.	2nd Oc. R. 1st Oc. R.	10 52 13 34	6 38·4
Tues	26	17 56 18 53	Occultation of b^2 Virginis (5) Reappearance of ditto	1st Tr. E. 3rd Ec. D. 3rd Ec. R.	10 44 16 1 52 19 35 42	6 34·4
Wed	27					6 30·5
Thur	28			2nd Ec. D.	18 43 34	6 26·5
Fri	29			4th Sh. E. 4th Tr. I.	12 37 19 29	6 22·7
Sat	30	6 34	● New Moon	2nd Sh. I. 3rd Tr. E. 2nd Tr. I. 2nd Sh. E. 1st Ec. D.	13 35 14 30 16 8 16 31 17 25 36	6 18·7
DEC. *Sun*	1	9 58 19 43	Conjunction of Mars and η Virginis (3·1m.) W. Conjunction of Moon and Mercury, 0° 35′ N.	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	14 34 15 48 16 54 18 8	6 14·7

SUN.

Greenwich, Noon. 1872.	Heliographical western longitude of the centre of the sun's disc.		Heliographical latitude of the centre of the sun's disc.	Angle of position of the sun's axis.
	°		°	°
Nov. 1	331·38	13·20	+4·11	24·52
2	344·58	13·20	4·00	24·34
3	357·78	13·20	+3·89	24·15
4	10·98	13·20	3·79	23·95
5	24·18	13 20	3·68	23·75
6	37·38	13·20	3·57	23·54
7	50·58	13·20	3·46	23·32
8	63·78	13·20	3·34	23·09
9	76·98	13·20	3·23	22·85
10	90·18	13·20	+3·12	22·61
11	103·38	13·20	3·00	22·36
12	116·58	13·20	2·88	22·10
13	129·78	13·19	2·77	21·83
14	142·97	13·20	2·65	21·56
15	156·17	13·20	2·53	21·28
16	169·37	13·20	2·41	20·99
17	182·57	13·20	+2·29	20·69
18	195·76	13·19	2·17	20·39
19	208·96	13·20	2·05	20·08
20	222·16	13·19	1·93	19·76
21	235·35	13·20	1·80	19·43
22	248·55	13·20	1·68	19·10
23	261·75	13·19	1·55	18·76
24	274·94	13·20	+1·43	18·41
25	288·14	13·19	1·30	18·06
26	301·33	13·19	1·18	17·70
27	314·52	13·20	1·05	17·33
28	327·72	13·19	0·92	16·96
29	340·91	13·20	0·80	16·58
30	354·11	13·19	0·67	16·19
Dec. 1	7·30		0·54	15·80

Daily rate of rotation, 14°·20.

MOON.

12h. Greenwich mean time. 1872.	LIBRATION. Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* centre in the zenith. colong.	lat.	SUN'S PLACE. *Sun's* centre in the zenith. colong.	lat.	TERMINATOR. Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets. 60° N.	0°	60° S.
	°	°	°	°	°	°	°
						SUNRISE.	
Nov. 6	90·34	+5·63	345·10	+0·52	76·0	75·1	74·2
7	89·30	6·39	357·27	0·50	88·1	87·3	86·4
8	88·27	6·76	9·44	0·47	100·2	99·4	98·6
9	87·29	6·72	21·60	0·44	112·3	111·6	110·8

10	86·42	+6·29	33·76	+0·42	124·5	123·8	123·1
11	85·71	5·48	45·90	0·39	136·6	135·9	135·3
12	85·18	4·37	58·05	0·36	148·7	148·1	147·5
13	84·90	3·03	70·19	0·32	160·7	160·2	159·6
14	84·87	1·53	82·33	0·29		Sunset.	
15	85·11	+0·02	94·46	0·26	4·0	4·5	4·9
16	85·62	—1·49	106·60	0·23	16·2	16·6	17·0
—							
17	86·37	—2·89	118·74	+0·20	28·4	28·7	29·1
18	87·35	4·13	130·88	0·17	40·6	40·9	41·2
19	88·48	5·18	143·03	0·13	52·8	53·0	53·3
20	89·73	5·98	155·18	0·10	65·0	65·2	65·4
21	91·02	6·53	167·33	0·07	77·2	77·3	77·5
22	92·28	6·80	179·49	0·05	89·4	89·5	89·6
23	93·44	6·77	191·66	+0·02	101·6	101·7	101·8
—							
24	94·44	—6·45	203·83	—0·01	113·8	113·8	113·8
25	95·18	5·82	216·01	0·04	126·1	126·0	126·0
26	95·64	—4·89	228·19	—00·7	138·3	138·2	138·1

Colong. = 90° —λ.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN NOV., 1872.

By W. R. Birt, F.R.A.S., F.M.S.

On p. 226 of the September number of the present volume the value of supplement of ☾ — ☉ on August 18, 1871, is quoted at 147° 16′·7, and on p. 240, of vol. ix., the value of supplement ☾ — ☉ is given as 143° 10′·9 on October 16, 1871. On November 3 supplement ☾ — ☉ = 144° 40′·7. The lists for August and October, 1871, may be consequently consulted for the selection of objects for observation in November, 1872.

Eleventh Zone of objects from North to South, 25° *to* 30° *W. long.*

Euctemon (east part), Meton,* (west part), Baily, Burg, Plana, Lacus Mortis, Posidonius, Mount Argæus, Dawes (*a*), Jansen, Maskelyne,* Mädler (*b*), Theophilus, Beaumont, Riccius, Nicolai,* Pitiscus,* Mutus, Manzinus, Schomberger (the middle part).

Objects marked thus (*) have not been mentioned in the monthly lists.

(*a*) The crater N.W. of Plinius has been named Dawes.

(*b*) The crater N.W. of Theophilus has been named Madler, by Schmidt.

My thanks are due to the author of the positions of the terminator, etc., for furnishing the readers of the *Register* with some remarks relative to the choice of a well marked fundamental point of reference near the middle of the moon's disc, on which, perhaps, I may be permitted to offer briefly my views. I perfectly agree with the proposal for "a correct survey of a great many of the leading points of the moon's disc," as essential for the progress of selenography, and I should much like to see not only the determination of the selenographical cöordinates of Mösting A, or Triesnecker B, by means of a new and special investigation of the moon's librations, but the mode to be adopted with the requisite measures and formulæ for deducing the cöordinates of the leading points from the cöordinates of the fundamental point of reference, and how far such measures and formulæ may differ from the mode of determining points of the second order adopted by Mädler. As the accuracy of Mädler's points of the first order has been called in question would it not be well in the new triangulation proceeding from the fundamental point to redetermine each of Beer and Mädler's points of the first order, so that their triangles may, by the determination of included points, be divided into several smaller triangles ? This would contribute to a real and important advance in selenography.

ECLIPSE OF THE MOON.

Partial eclipse of the moon, visible at Greenwich, November 14.

	G. M. T.
First contact	15 1·7
First contact with the shadow	17 1·7
Middle of the eclipse	17 19·4
Last contact with the shadow	17 37·1
Last contact with the penumbra...	19 37·1

Magnitude of the eclipse = 0·023

MINOR PLANETS.

The following minor planets *) come into opposition :—

1872.				Mag. m.	A.R. h. m.	P.D. °
Nov. 2	Cassandra	(114)	...	11·1	2 54	80·2
3	Alexandra	(54)	...	11·3	2 34	55·8
4	Antiope	(90)	...	11·6	2 40	76·1
5	Proserpina	(26)	...	11·0	2 44	74·3
5	Pandora	(55)	...	10·1	2 43	67·0
6	Daphne	(41)	...	11·5	3 4	89·2
8	Lydia	(110)	...	10·7	3 0	74·8
10	Eugenia	(45)	...	11·1	3 3	82·9
12	Isis	(42)	...	10·3	3 11	81·1
Dec. 5	Maja	(66)	...	11·7	4 55	62·3
8	Leto	(68)	...	10·5	4 57	60·7
13	Victoria	(12)	...	10·8	5 26	72·7
16	Lomia	(117)	...	11·3	5 49	44·5
21	Calliope	(22)	...	9·1	6 2	57·7
24	Sirone	(116)	...	10·4	6 19	63·8
26	Sappho	(80)	...	10·5	6 21	79·2
27	Thisbe	(88)	...	11·7	6 27	66·5

*) or "Zenareides," if an old suggestion of a name, which would embody the chief characteristic of their orbits, be fancied.

Erratum in last number. Page 233, line 13 from top, dele the comma between "Pallas" and "Athena." (It is of course one name.)

ASTRONOMICAL REGISTER—Subscriptions received by the Editor

To Sept., 1872.
Barneby, T.
Rivaz, Miss
Walton, T.

To Nov., 1872.
Hutchings, Rev. R. S.

To Dec., 1872.
Adams, S.
Cook, James
Cundell, G. S.
D'Alquen, F. M.
Dix, F.
Freeman, G. T.
Hemming, Rev. B. F.
Lancaster, J. L.
Lancaster, W. L.
Numsen, W. H.
Perrins, J. D.
Petty, Thomas
Rump, H. R.
Shawcross, W.
Vines, D.
Watson, J.

To Jan, 1873.
McAdam, J. V.

To March, 1873.
Court, T.
Hendry, W.

To June, 1873.
Dale, R. S.

To Dec., 1873.
Birt, W. R.
Horner, Rev. J.

TO CORRESPONDENTS.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, Hackney Collegiate School, *Clarence Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 120. DECEMBER. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1872—73.

First Meeting, November 8th, 1872.

Professor Arthur Cayley, F.R.S., *President*, in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last meeting were read and confirmed.

One hundred and sixteen presents were announced, and the thanks of the Society voted to the respective donors. A portrait of the late Sir James Clarke Ross, the arctic and antarctic explorer, and the Report of the Italian Astronomers of their observations on the Eclipse of 1870, very beautifully got up and illustrated, were among the presents.

Mr. Dunkin announced that two more minor planets had been discovered at Paris on the night of the 5th—6th November; the first by M. Paul Henry, and the second by M. Prosper Henry. They are both about 11½ magnitude, and make the number of planetoids now 127.

A. H. Hadley, Esq.

was balloted for, and duly elected a Fellow of the Society.

M. Janssen, Professors Simon Newcombe, H. A. Newton and Respighi, Dr. Rutherfurd, and Professors Schiaparelli, Young, and Zollner, having been duly recommended by the Council, according to the bye-laws, were balloted for and elected Foreign Associates of the Society.

The following papers were announced and some of them read:

Mean places of 78 Stars near the South Pole, observed at the Royal Observatory, Cape of Good Hope: by Mr. E. J. Stone.

Mr. Dunkin said that although much occupied in reducing past observations, Mr. Stone had not neglected current work, and that this was probably one of the most important contributions from the southern hemisphere which the Society had ever received.

Sir G. B. Airy, Astronomer-Royal, remarked that the meeting ought not to pass over this valuable paper without animadverting to the great difficulty under which the work had been performed, Mr. Stone having unexpectedly to struggle with the masses of unreduced observations left by his predecessor at the observatory.

Ephemeris of the angle of position and distance of the Binary Star, a Centauri: by Mr. Hind.

The author called attention to the interesting changes about to be witnessed in this system at the nearest approach of one star to the other, which he had calculated for 1875, the elements used being those of Mr. Eyre Burton Powell, of Madras.

Note on the first Comet of 1818: by Mr. Hind.

In the last number of the *Monthly Notices,* Professor Herschel refers to the similarity of the orbit of this Comet and of a periodical meteor shower in December. Mr. Hind now gave a fresh determination of the elements of the former.

Note on the Binary Star a Geminorum: by Mr. Hind.

Several communications have lately been made as to the orbit of this pair, but Mr. Hind points out that the authors have overlooked the elaborate investigations of Professor Thiele, the Danish astronomer, which show that it is quite unnecessary to resort to the improbable hypothesis of hyperbolic motion.

On the probable early appearance of the Comet of the November Meteors: by Mr. Hind.

On Lord Lindsay's preparations for observing the Transit of Venus in 1874: by Lord Lindsay and Mr. D. Gill.

An account of the preparations made for observing the transit of Venus, so far as at present matured, will doubtless be interesting to the Society; but on many points they must stand over for future communications. Lord Lindsay has selected the Island of Mauritius as his station, on account of its more favourable meteorological conditions as compared with other places having greater astronomical advantages. The methods of observation to be employed are: I. Observations of the internal contacts to be worked out on the plans of Halley or Delisle. II. Observations of the first external contact at the chromosphere, to be made with a spectroscope. III. Photographic pictures. IV. Heliometric measures. It has been ascertained that two observers can make use of all these plans, and arrangements have been made accordingly. Each of the methods referred to has its own advantages, and it is desired to combine all if possible. The first

method involves a knowledge of the latitude and longitude of the station, and correct time there. It is not yet settled whether any galvanic communications will be available, but at present for the longitude it is intended to use transits of the moon with an altazimuth made by Simms. It is believed the Germans will also have a station on the Mauritius, and will determine their geographical position very carefully; and Lord Lindsay will then connect his station with theirs by triangulation. The transit instrument to be used will be described at a future meeting. It has 4 inches aperture, and is made by Cooke. The clock is one by Frodsham, and there is also a chronograph with 4 barrels, each of which can be worked separately, so that each instrument will have its own recording barrel, thus avoiding all confusion. The chronograph can be kept in motion for 4 hours, which will cover the whole time occupied in the transit. Lord Lindsay intends to observe the external contact with the chromosphere himself, and Mr. Gill the internal contacts with a telescope. It is pretty well understood that the photographs, to be useful, must be 4 inches in diameter; and, in order to obtain perfect pictures, the rays should fall as little obliquely as possible. This appears to be fulfilled by the method proposed by Professor Winlock, who suggests a telescope of 40 feet focal length, placed horizontally, and a heliostat to reflect the sun's image along it. At first, Lord Lindsay ordered a simple lens of Dallmeyer, but has now arranged to ensure the great advantage of an achromatic one, which is promised by the end of this year. It is intended to have 2 planes to the heliostat, one mounted on a polar axis and another to send the rays down the tube. Lord Lindsay had never met with an instrument that answered his requirements until he saw the siderostat made by M. Foucault, of Paris, which was the very thing he wanted; and he had accordingly ordered one to be made with 16-inch mirrors. These are unusually large, but the instrument can be applied afterwards to other purposes. Much fear has been expressed, especially by Americans, as to the effect of distortion of the apparatus by the heat to which it will be exposed; but Professor Wolff states that no such effect is produced by exposure to the sun's rays for two hours. Mr. Howard Grubb has made a 13-inch unsilvered mirror, to fit the telescope to be taken out. Fiducial lines cannot be relied on, and therefore it may be better to do without them entirely, and make the measures from the centre of the sun, as with the heliometer. As there is a question whether the line of direction can be exactly determined, measures of position angles should be dispensed with as the micrometer gets heated. As to the heliometric method, it is not much in favour in this country, and none of the government

expeditions will be supplied with such instruments. The Germans like it better, and will send a heliometer to Kerguelen's Land, as their Mauritius station will not be so good for corresponding with one they intend to occupy in China. The Russians will have them at Lake Baikal and the mouth of the River Amoor. Messrs. Repsold, of Hamburgh, have undertaken to make a heliometer for Lord Lindsay, like the Russian instruments, with all the improvements used in the Oxford instrument as well as some others. It will, therefore, include the motion of the halves of the object glass in curved slides, so that the images will remain in focus; unlimited rotation of the tube in the cradle; the measurement of position angles at the eye end, and measures of the micrometer read there also. Some new points are, the graduation of the slides of the object glass side by side, so as to be read by the same microscope; an arrangement to shut off light from half the object glass, so as to equalise the light of the images; and the introduction of a thermometer at the end of the tube. Most of these improvements were indicated by Struve. Messrs. Repsold only undertake the object glass and tube; the equatorial mounting is to be by Cooke. These details are submitted in the hope that any astronomers used to the instrument will offer their advice and assistance. It is desired by the observations to eliminate personality, and to avoid or properly estimate the effects of changes of temperature and of atmospheric conditions. Lord Lindsay explained, and illustrated by a series of diagrams, the method of observation with the heliometer, and the way in which all the necessary corrections for instrumental errors would be made. He proposed to eliminate errors of division, as affected by temperature, by placing the instrument on one of the collimating piers of his transit circle in his observatory at home, and heating the room by gas to different temperatures. As to the measure of accuracy to be expected from the heliometer results, it was thought that the error of observation would not exceed $0''\cdot5$, and that if each series included 10 measures this would be reduced to $0''\cdot1$, and if 10 such series were obtained to $0''\cdot056$. The effects of such an error on the result would be only $0''\cdot018$ of parallax, but it was hoped that the original error would be less than $0''\cdot5$, and that therefore the result would be one of extreme accuracy.

On the examination of the Photographs taken during the total solar Eclipse of December 11—12, 1871: by Colonel Tennant.

In his report of the observations at Dodabeta the author expressed his opinion that there was a marked connection between the protuberances and the configuration of the corona, and this upon minute examination of the pictures he finds confirmed. The photographs have been measured as to this point with the

assistance of Dr. De la Rue. The negatives were placed in an oxyhydrogen lantern and projected on a card, where they were traced of a size which rendered them capable of being measured in Dr. De la Rue's micrometer. Besides showing the coincidences between the prominences and the rifts of the corona, an attempt was made to deduce the line of the moon's motion from the corona as well as from the passage over the protuberances, and the motion was always found in the right direction. Indeed, the general motion of the moon, with respect to the corona, was found to be the same as with the protuberances. Every peculiarity of the corona, especially the salient points of the rifts, could be traced through all the series, and could be measured with the micrometer used. Thus a long ray, which in No. 1 was very remarkable, was in No. 3 contracted and shorter; but in No. 3 everything was less than in No. 1, so that the result was the same. The measures were made by Dr. De la Rue and verified by Col. Tennant, but he acknowledged that the former were the most reliable. While the examination entirely confirms the general permanency of the corona, it cannot be said that it does any more. The author prefers resting the evidence of the moon's motion on the comparison of his pictures with those taken by Lord Lindsay at Bekul, when the corona was permanent for a time longer than the period occupied in taking the photographs.

On the rate of a clock going in a partial vacuum: by Mr. Carrington.

The author found great difficulty in making the necessary arrangements for procuring the vacuum, as his mahogany clock case leaked and the glass cracked. At last he succeeded with a copper case having a glass front, of which, however, eight were broken before he obtained one strong enough. The paper gave the details of a number of series of observations for clock rate, with a vacuum ranging fram 27·5 to 29 inches, which showed that while the rate remained very uniform at each diminished pressure, an alteration in this produced a marked change in the rate.

On a proposed double altazimuth: by Mr. Carrington.

The author suggested the construction of a new instrument, being a double altazimuth, capable of reversion in all its parts, having open mirrors or lenses without tubes. He described it in great detail with the aid of drawings, but admitted that from its enormous dimensions and consequent expense, it was never likely to be made, if even the difficulty of construction of some parts could be surmounted.

On a modified form of solar eyepiece: by Mr. Browning.

The instrument was exhibited, and Mr. Browning stated that

it had seemed to him that in the ordinary construction, the prism being placed with its face at an angle of 45° was about the best position for reflecting all the light possible, instead of getting rid of it. He had, therefore, tilted the prism until the rays fell nearly at a right angle, and the effect was even better than he had expected.

On an observing chair for a reflecting telescope on the Newtonian principle: by Mr. Browning.

This chair was originally designed by Mr. Knobel, who had sent it to Mr. Browning, requesting his opinion and suggestions for its improvement. Mr. Browning exhibited a model, in which he had replaced the solid uprights by hollow tubes, containing counterpoises slightly in excess of the weight of the chair, and by the regulation of these the observer could raise and lower himself with facility.

On the origin of the November meteors: by Mr. Proctor.

In the application of Schiaparelli's theory of the connection between comets and meteors, it had generally been considered that such bodies were drawn into the solar system, in consequence of the attraction of the planets they might pass near. The author observed that a meteor passing near Uranus with a velocity of six miles per second, which corresponded to the known velocity of such bodies near the sun, would lose 4½ miles of such velocity, but to do this it must pass as close as the nearest satellite of Uranus. He thought the probability of this very small, and that there was another way of getting over the difficulty, viz., by supposing that Uranus at some time had expelled these meteoric bodies from its own mass. The force required for this purpose so as to drive the body beyond the sphere of the planet's attraction, would not require a very great velocity, as 13½ miles per second would be sufficient, whereas if expelled from the sun it would have to be 375 miles. If such comets were found to be near Jupiter, they also might easily have been expelled from the planet, instead of being drawn from outer space.

On the diffraction of object-glasses: by Mr. Strutt.

In observing the sun, in order to obviate injurious effects to the eye, it is usual to contract the object-glass, but in doing so definition is sacrificed, and the image becomes a patch of light surrounded by rings. In making star measures, if the aperture be diminished the resolving power suffers. It has occurred to the author that it would be otherwise if the centre of the glass were stopped out, and a ring at the circumference left open, and he entered into a mathematical discussion of the subject.

Capt. Noble said it was a very old dodge in separating double stars to put a patch on the centre of the glass.

Mr. Dunkin said the Astronomer Royal wrote a paper on the subject 40 years ago.

On the arc of the meridian measured in South Africa: by Mr. Todhunter.

The author finding some deficiencies in the account of this operation, is anxious for explanation on certain points.

On a coloured cluster about κ Crucis: by Mr. Russell.

On a volcanic appearance on the sun: by M. Chacornac.

On July 29, this observer saw a great flame on a spot. It seemed to be a shining protuberance 7″ in diameter and of a blue tint.

On the parallax and proper motion of Lalande 21,185: by Mr. Lynn.

Dr. Winnecke having found an approximate parallax of 0″·501 for this star, the author has compared the Greenwich observations of the objects and finds they agree in giving the same proper motion that Argelander does.

Graphic conversion of stellar co-ordinates: by Mr. Freeman.

In order to avoid any difficulty in setting altazimuths, on account of converting R.A. and Declination into altitude and azimuth, Mr. Freeman has constructed a graphic projection of curves, showing the correspondence of the elements, of which he exhibited a photographic copy.

Future solar eclipses: by Mr. Maguire.

On changes in the nebula surrounding η Argus: by Mr. Abbott.

The author sent a fresh drawing and measures of this object.

Observations on the zodiacal light: by Mr. Fasel.

List of co-ordinates of stars within or near the Milky Way: by Mr. Marth.

The meeting then adjourned.

ASTRONOMICAL ALLUSIONS IN HOMER, DANTE, SHAKESPEARE AND MILTON.

By G. J. Walker.

IV.—Milton.

Born 1608; died 1674.

Though the famous work of Copernicus, *De Revolutionibus*, &c., had been published much more than a century before Paradise Lost was written, in that great poem there is only the possibility of its truth expressed. One reason assigned by Addison (Spectator, No. 345), is that "it would have been highly absurd to have given the sanction of an archangel to any particular system of philosophy." Nevertheless Raphael is more than once committed to erroneous physics, or explanation of phenomena (Paradise Lost, V., 415-426; VIII., 145-148). In 1637, Milton visited Galileo in his confinement at Florence. Though he seems to have really held with the great Tuscan, he probably, as science was not his forte, thought it advisable to make the angel withhold his sanction both from

the Ptolemaic and the Copernican system. It may be questioned if he would have done so had he lived in later times, when the true system of the universe became generally acknowledged. But the *Principia* of our immortal Newton had not yet appeared. Such systems as the Ptolemaic and Tychonic are described as "quaint opinions":—

——"When they come to model heav'n
And calculate the stars, how they will wield
The mighty frame! how build, unbuild, contrive,
To save appearances; how gird the sphere
With centric, and eccentric, scribl'd o'er,
Cycle, and epicycle, orb in orb."
—Paradise Lost, VIII., 78, &c.

This is spoken by Raphael, who a little further on alludes to the system of Copernicus as follows:—

——"What if the sun
Be centre to the world; and other stars
(By his attractive virtue and their own
Incited) dance about him various rounds?"
—VIII, 122, &c.

But the conclusion is, that Adam is advised by Raphael not to trouble himself about such hidden things as whether the earth moved and revolved on its axis or not. The poet, however, who might easily have avoided the positive adoption of any theory, by representing such matters as left to be unravelled in the course of time by human ingenuity rather than to be taught by revelation, is sometimes scarcely consistent on the ground he has chosen. In Paradise Lost, IV., 593, &c., describing Uriel's descent on the sunbeam back to the sun which had set, he leaves it doubtful:—

——"Whether the prime orb,
Incredible how swift, had thither rowl'd
Diurnal; or this less voluble earth,
By shorter flight to th' east, had left him there," &c.

Yet in IX., 103, &c., Satan speaks of the earth like a decided Ptolemaist:—

"Terrestial heav'n! danc'd round by other heav'ns
That shine, yet bear their bright officious lamps,
Light above light, for thee alone, as seems," &c.

Whilst Raphael appears to have no settled views on the subject:—

"To ask or search, I blame thee not; for heav'n
Is as the book of God before thee set:
Wherein to read his wond'rous works, and learn
His seasons, hours, or days, or months, or years.
This to attain, whether heav'n move or earth,
Imports not, if thou reckon right: the rest,
From man or angel, the great architect
Did wisely to conceal; and not divulge
His secrets to be scann'd by them who ought
Rather admire. Or, if they list to try
Conjecture," &c.—VIII., 66, &c.

Yet who can doubt that angels, both good and bad, must know the truth concerning these things? Remembering the poet's blindness, and the interruptions in the composition of his work, perhaps these inconsistencies are not surprising.

Of now long exploded errors that still linger in Paradise Lost, are the following. An eclipse of the sun is ominous:—

"As when the sun . . .
——from behind the moon,

In dim eclipse, disastrous twilight sheds
On half the nations, and with fear of change
Perplexes monarchs," &c.—I., 596, &c.

This passage, it is said, nearly occasioned the suppression of the poem by the Licenser, whose office had been restored by Charles II. See also "Lycidas."

The well-known allusion to the disastrous influences of comets, II., 708, &c., when Satan,

———"like a comet burn'd,
That fires the length of Ophiuchus huge
In th' arctic sky, and from his horrid hair
Shakes pestilence and war."

And XII., 633, &c.:—

"The brandish'd sword of God before them blaz'd;
Fierce as a comet."

Evil influences of planets and stars are referred to, X., 657-664. See also "Arcades." Stars show the future, Paradise Regained, IV. They derive their light from the sun, Paradise Lost, VII., 364-365; Harmony of the Spheres, V., 625; also 'Arcades.' We proceed now to notice the principal allusions to the heavenly bodies.

The Sun.—Its beams are said to be magnetic, Paradise Lost, III., 583. Satan in the sun is thus described:—

"There lands the fiend, a spot like which perhaps
Astronomer in the sun's lucent orb
Through his glaz'd optic tube yet never saw."—III., 588, &c.

When the sun rose at the Creation,

———"the gray
Dawn and the Pleiades before him danc'd,
Shedding sweet influence."—VII., 373, &c.

This appears to refer to the heliacal rising of the Pleiades, at which time the sun's longitude is now about 80 degrees. Allowing, therefore, for precession, the sun would have been in Taurus at the vernal equinox at the vulgar epoch of the Creation; the moon being also full (see following verses). Milton, therefore, follows the common chronology.*

The sun's path is supposed to have been changed after the Fall:—

"Some say, he bid his angels turn ascanse
The poles of earth, twice ten degrees, and more,
From the sun's axle; they with labour push'd
Oblique the centric globe: some say, the sun
Was bid turn reins from th' æquinoctial road
Like distant breadth to Taurus, with the sev'n
Atlantic sisters, and the Spartan twins,
Up to the Tropic Crab; thence, down amain
By Leo, and the Virgin, and the Scales,
As deep as Capricorn; else had the spring
Perpetual smil'd on earth with vernant flow'rs," &c.
—X., 688, &c.

Speculations concerning the change of inclination of the earth's axis date from ancient times; and still have an attraction to some. Of course on the hypothesis of a miracle, it may have been changed, and may yet be again; and such a perpetual spring as the inhabitants of Jupiter (if there are any) enjoy, may be thus enjoyed on the earth too. Aug. Compte had the audacity to speculate on the advantages which would be derived, "if the combined efforts of the human race should ever permit

* Archbishop Ussher, however, fixes the first day of the world upon the entrance of the night preceding the twenty-third day of *October* (being our Sunday) B.C. 4004. Who is to decide?

us to readjust the axis of rotation of our globe on the plane of its orbit, provided that such an improvement were carried out with requisite wisdom." C. Flammarion, remarking that Compte could not have been serious in this idea, adds, "Everyone knows that we are upon the earth like ants upon the cupola of the Pantheon.*

Addison says (Spectator, No. 369), that, "from Adam's first appearance in the fourth book to his expulsion from Paradise in the twelfth, the author reckons ten days." Adam and Eve, however, had been sometime created before the fourth book (see IV., 449, 640, 680, 710; and in X., 327, &c., after the Fall, we find the sun rising in Aries, and Satan moving off at the opposite quarter of the heavens:—

"Satan in likeness of an angel bright,
Betwixt the Centaur, and the Scorpion steering
His Zenith, while the sun in Aries rose."

Which compared with VII., 373, already quoted, implies a full year elapsed.†

———"Whose orb
Thro' optick glass the Tuscan artist views
At ev'ning, from the top of Fesole,
Or in Valdarno, to descry new lands,
Rivers or mountains, in her spotty globe."—I., 287.

Raphael sees the earth at a distance,

"As when by night the glass
Of Galileo, less assur'd, observes
Imagin'd lands and regions in the moon."—V., 261, &c.

It is supposed to be inhabited:—

"Those argent fields more likely habitants,
Translated saints, or middle spirits hold,
Betwixt th' angelical and human kind."—III., 460, &c.

A moonlight night is described as follows:—

———"Now glow'd the firmament
With living saphirs; Hesperus, that led
The starry host, rode brightest; till the moon,
Rising in clouded majesty at length,
Apparent queen, unveil'd her peerless light,
And o'er the dark her silver mantle threw."—IV., 604, &c.

The morning and evening stars are mentioned, V., 166, &c.; 708, &c.; IX., 49; 'Lycidas'; and the phases of Venus, VII.. 366, &c.

Stars.—The polar star is called the

"Star of Arcady,
Or Tyrian cynosure."—Comus.

The Little Bear was regarded as the Arcadian maiden Kallisto. Cynosura (Kunos Oura), the Dog's Tail, is the same constellation; used by the Phœnicians in navigation.

In Paradise Lost, III., 557, &c., Satan surveys the compass of the heavens:—

——"From eastern point
Of Libra, to the fleecy star that bears
Andromeda far off Atlantic seas,
Beyond th' horizon."

* "*La Pluralité des Mondes,*" *&c.*, p. 167.

† We have seen Dante's opinion about the space of time during which our first parents remained in Paradise. Adam did not continue more than half-a-day in Paradise, according to the opinion of the Musulmans, which in this is conformable to that of the Rabbins; but they explain that a day of the other world, or of Paradise, corresponds to a thousand of our years; therefore by that half-day must be understood 500 years (D'Herbelot, *Bibliotheque Orientale*, S. V. Adam). In the absence of positive information persons must adopt their own conclusions; but there can be little doubt which of these extreme views is nearer the truth.

THE MOON.—The shield of Satan is compared to the moon in a familiar passage:—
The "fleecy star" is Aries. The stars are probably inhabited, III., 565-571; or destined to be:—

——"Every star perhaps a world
Of destined habitation."—VII., 621.

They shed a virtue on what grows on the earth, IV., 670, &c. The Almighty is represented as hanging forth in heaven:—

————"His golden scales, yet seen
Betwixt Astræa, and the Scorpion Sign."—IV., 997, &c.

Astræa of course is Virgo. The Milky Way is mentioned, VII, 579, &c:—

————"That milky way,
Which nightly, as a circling zone, thou seest
Powder'd with stars."

The Lady in "Comus," upbraids the Night for closing up in her dark lantern the stars—

"That nature hung in heaven, and fill'd their lamps
With everlasting oil, to give due light
To the misled and lonely traveller."

FALLING STARS.—Uriel's gliding on a sun-beam was

————"Swift as a shooting star
In autumn thwarts the night, when vapours fir'd
Impress'd the airs, and shew the mariner
From what point of his compass to beware
Impetuous winds."—IV., 556, &c.

Satan is to fall from heaven—

————"Like an autumnal star,
Or lightning."—Paradise Regained, IV., near end.

The attendant spirit in Comus, says:—

"Swift as the sparkle of a glancing star
I shoot from heaven."

Mulciber, or Vulcan, thrown from heaven by Jove—

"Dropt from the zenith like a falling star."
—Paradise Lost, I. 745.

A few more particulars only, of a miscellaneous character, remain to be noticed. Milton understood the waters above the firmament of a super-celestial ocean:—

"The waters underneath from those above
Dividing: for as earth, so he the world
Built on circumflous waters calm, in wide
Crystalline ocean."—Paradise Lost, VII., 268, &c.

He seems to have regarded all the heavenly bodies as suffering from the effects of the Fall, Paradise Lost, X., 397-398, 410-414. The Star of the Magi is represented as "a star unseen before in heaven," XII., 360. This is much better than the fancy of Kepler, about a conjunction of Jupiter and Saturn,—a fancy taken up and worked out afterwards by Ideler. It was doubtless a luminous meteor miraculously prepared for the occasion. The subject is well and elaborately discussed in Smith's Dictionary of the Bible (*Star of the Wise Men*).

The telescope is once more alluded to in Paradise Regained, IV., near the beginning, when Satan in the Temptation shews our Lord the glories of Imperial Rome:—

"By what strange parallax, or optic skill
Of vision, multiplied through air, or glass
Of telescope, were curious to enquire."

Where "curious," means over-inquisitive. A few lines further on, Satan calls the contrivance his "airy microscope."

Other solar systems are hinted at:—

————"And other suns perhaps,
With their attendant moons, thou wilt descry,
Communicating male and female light."
—Paradise Lost, VIII., 148, &c.

Where "male and female light," refers to self-luminous bodies, and those which shine by reflected light; though Smyth (Cycle I., p. 301; Specul. Hart., p. 319) seems to understand by it also complementary colours.

Perhaps, on the whole, Milton could hardly have done better than he has, in the pretty fiction in which he describes the introduction of light. Paradise Lost, VII., 243, &c.:—

"Let there be light! said God: and forthwith light
Ethereal, first of things, quintessence pure,
Sprung from the deep: and from her native east,
To journey through the aëry gloom began,
Sphear'd in a radiant cloud:"

Probably the refinements of science will never lead to the full comprehension of the mystery of light, though far from being the deepest among the deep things which exercise the human mind. To the Voice that spake from the whirlwind more than 3000 years ago, and demanded, "Where is the way where light dwelleth? . . . Knowest thou it, because thou wast then born? or because the number of thy days is great?" (Job xxxviii. 19-21). Can we even now return an exhaustive reply? The name itself, in Hebrew, Ōr, is remarkable: "the oldest of all words; the first word ever recorded to have been pronounced" (see the interesting remarks of Sir John Herschel, in *Familiar Lectures on Scientific Subjects*, p. 219). If Milton here, as also in other instances, is at fault, it must be remembered that there is but one Book, which though written in periods of various antiquity, possesses with its other peerless excellencies, the characteristic of never being irreconcileable with science, though so often fearlessly touching its domain, in the language and figures of common life.

Such are the principal astronomical allusions which I have found in these four great poets; and the brief review of which, I trust, will not be unacceptable to the Hackney Scientific Association. As far as I know, there is no poem of modern date expressly dedicated to astronomy. Aratus and Manilius seem to have had no successors. And if there be truth in the assertions that "poetry and science are two rival and hostile powers," and "that it is impossible to treat any subject at once scientifically and poetically," we must not expect ever to see a superior astronomical poem; notwithstanding that the same person (as has been the case) may be both poet and astronomer. Still astronomical subjects have, doubtless, sometimes been clothed in 'creditable verse; and the heavens afford a better field than that chosen by Erasmus Darwin.' An astronomical poem that should reproduce the beauties of "*The Botanic Garden*," and avoid its frequent faults, may possibly sometime appear. A Dante or a Milton is not needed for this work; and by such as they (if such ever appear again) it would probably never be attempted. Is it too much to hope for an English Lucretius, without his Epicureanism and absurd views? What a work might the Roman poet have produced had he lived in our days! If indeed there should ever arise another like him, who shall consecrate to Urania that "marvellous ability and skill with which the most abstruse speculations and the most refractory technicalities have been luminously bodied forth in sonorous verse, and

expressed in diction which, although full of animation and dignity, is never extravagant nor pompous,"* we shall possess something of more interest than the scattered allusions to which attention has been called in this paper; something that would deserve to be hung on the walls of our observatories in characters of gold, like the famous *Mu'allakāt*, or "suspended" poems of the Arabs, in their temple at Mecca.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

REFRACTORS AND REFLECTORS COMPARED.

Sir,—I send some particulars of a comparison made between a reflector and refractor of considerable size, under circumstances which were, in many respects, unusually favourable.

The instruments, a 7½ inch o.g., by Alvan Clarke, of 110-in. focus, formerly belonging to the Rev. W. R. Dawes; and a 9-inch speculum of silvered glass, 81-in. in focal length, are the property of Wentworth Erck, Esq., of Sherrington Bray, Co. Wicklow, who acted as one of the observers in making the comparison, and has kindly permitted the results to be made use of in drawing up this statement. We decided upon using two methods for ascertaining: 1st. The relative illuminating power, and 2nd, The defining qualities of the instrument compared.

The method first adopted was to direct the two telescopes, placed side by side, upon a distant terrestrial object, a black board bearing well-defined white marks, to which was attached a watch dial 1½ inch in diameter.

The appearance of these objects in the two instruments was carefully studied, with powers, first of 100 on both, then with 269 on the achromatic and 276 on the reflector, which latter instrument gave harder and better-defined outlines with its full apertures than the former did.

The relative illuminating power was tested by watching the gradual fading of the above-mentioned objects in the evening twilight, with the two telescopes armed with the eye-pieces previously employed for the comparison of defining power. With the full aperture of each in use, Mr. Erck considered that the object was sensibly of the same brightness in the two instruments, and that the refractor had the advantage in point of light, when the light receiving area of the reflector was reduced to an equality with that of its opponent.

In the first of the above cases the reflector appeared to me to have a slight but decided superiority, and in the second I was not able to determine which of the images was the brighter.

A great number of comparisons were made as long as the objects were visible, the eye being carried from one instrument to the other every two or three minutes, in regular alternation. A second series of comparisons was afterwards made when viewing celestial objects, both instruments being mounted equatorially, and provided with R.A. motion.

They were not more than 10 yards apart.

The objects selected were:

(1) 75 Cygni, dist. $2''.5, \pm$ pos. 322° mags. 4, 11. Dawes's scales.

(2) Lalande 42240, dist. $2''$, pos. $105^\circ \pm$ mags. 7½, 11. Dawes's scales.

* William Ramsay, in Smith's *Dictionary of Greek and Roman Biography and Mythology*.

(3) γ Andromedæ.
(4) Saturn and the fainter satellites.

Full aperture of both instruments in use unless otherwise noted.

(1) Was beautifully shown by both instruments, with 100± on the reflector and 93± on the achromatic, the first showing the comet quite clear of the primary, the other exhibiting the pair in contact.

(2) Was well seen at moments with 250 on the refractor, and barely suspected with 150 and 300 (single lens) on the reflector.

(3) 540, a single lens, on the reflector showed me the discs divided at best moments with a dark space between them, but owing to unsteady air I could not see whether the discs were truly round or compressed on their approximated sides.

With a compound microscopic eyepiece, giving a power of about 800 on the achromatic, I was not able even to see the wedge notched, but the flaring of the image was at this time considerable.

The reflector appeared to give harder and sharper stellar discs than its opponent, with the power above-quoted.

(4) Definition in both instruments extremely fine, steadier in the achromatic, but images otherwise undistinguishable.

3 faint satellites first seen by me with 150 on the reflector, at first seen by Mr. Erck with difficulty, using the achromatic armed with nearly the same power.

Afterwards we saw them distinctly with both instruments and power of 100 on each, and on reducing the apertures we found that the reflector showed the satellites with apparently greater intrinsic light than the achromatic, but that the field of the latter instrument was very perceptibly the darker of the two. Aperture 6·5-in. reflector, 5·25-in. achromatic.

We find the superiority in darkness of field when viewing a bright object to be always on the side of the achromatic, but the difference would, I believe, not be noticed except in a simultaneous comparison.

The silver film was not uniform in polish, being in many places somewhat cloudy.

The small mirror of the reflector was a 1¼-inch prism of very fine quality, and the disc which masked it was 1⅜-inch in diameter.

The results may be summed up briefly, that a refractor of given aperture will probably equal a reflector of one-seventh the greater aperture in illuminating power, but falls perceptibly below it in defining power.

It is probable also that the achromatic would be found to have the advantage in detecting faint objects in presence of a bright one, on account of its possessing apparently a slight advantage over its rival in blackness of field under similar circumstances.

It is possible that the deeper curvature of the lenses of a reflector's eyepieces, as compared with those giving the same power on an achromatic of similar diameter, but greater focal length, may account in part, at least, for the peculiarity referred to in the last paragraph. It was originally in contemplation to make a second series of comparisons between the two instruments, using one of Mr. Browning's beautiful flats in place of the prism before mentioned, but it has up to the present been found impracticable to carry out this intention.

I, therefore, venture to send you the above results, such as they are, in the hope that some of your readers who are interested in this question may possibly find them useful. It only remains for me to add that the method of comparing in daylight is due to the Rev. T. W. Webb (see *Register*, for 1869, p. 22), and with many apologies for the roughness of my notes, to remain, Yours truly,

Loughlinstown, Co. Dublin : CHARLES E. BURTON.
Nov. 13, 1872.

DISCOVERY OF THE PLANET VESTA.—IN REPLY TO J. S. G.

Sir, I have some recollections of having read somewhere that a *pupil* of Olbers discovered Vesta—perhaps it was in Arago's Lectures. No work, however, that I can refer to, makes any mention of this, and it seems irreconcilable with the details given by Delambre, (Astronomei 2. 555). Hind (Solar System), and Grant (History of Physical Astronomy, p. 241.)

Yours faithfully,
G. J. W.

ANCIENT ECLIPSES.

The following are the remaining eclipses mentioned in Ingram's translation of the *Saxon Chronicle* :—

A.D. 802.—" This year was the moon eclipsed at dawn, on the 13th day before the calends of January."

The full moon in December 801 was on the 23rd, and does not appear to have suffered eclipse ; and at the full moons in December 800 and 802 there was no eclipse. That alluded to seems to be the eclipse of May 21, 802. Commencement about 2h. 20m. a.m., greatest phase, nearly total, 3h. 55m., about sunrise.

806.—" This year was the moon eclipsed on the 1st of September, Edwulf, king of the Northumbrians, was banished from his dominions, and Eanbert, bishop of Hexham, departed this life."

There was a total eclipse of the moon on the evening mentioned, lasting from about 8h. 25m. till after midnight. The total phase, according to these approximate tables, was from 9h. 37m. to 10h. 59m.

807.—" This year was the sun eclipsed precisely at eleven in the morning, on the 17th day before the calends of August."

The eclipse meant must be that of February 11th, that year three-fourths of the sun's surface were obscured about a quarter past ten.

897.—" A band of pirates assembled, and sat at Fulham by the Thames. The same year also was the sun eclipsed one hour of the day."

No month is given. I did not find any visible eclipse of the sun this year. On examining the previous year I found a great eclipse on October 29. According to the approximate tables I used, totality came on at London about 1h. 14m. which is very near the truth, as Mr. Hind has shown by a more recent and rigorous computation. Mr. Hind has informed me that the central line ran nearly over Carnarvon, Warwick, and Hertford. The north limit by Blackburn, Sheffield, and Boston. The south limit close to Cardigan, Westbury, and Worthing. In Struyk's Catalogue of eclipses, given in Ferguson's astronomy, this is put down as a large partial eclipse at Paris. It is doubtful whether there was any eclipse of the sun total at London from 878 till 1715.

904.—" This year the moon was eclipsed."

I find two total elipses of the moon, one on May 31, from 9h. 22m. to 13h. 5m., totality continuing 1h. 41m., the other on November 25th, from 7h. 25m. to 10h. 51m., totality lasting 1h. 11m.

1121.—" The moon was eclipsed on the night of the nones of April, being a fortnight old."

There was a total eclipse of the moon on the night of April 4th, beginning about 7h. 23m., and lasting till about 11h. 19m.

S. J. JOHNSON.

Upton Helions Rectory,
Crediton, Oct. 2.

MR. BIRD'S TRIPLE STAR IN DRACO.

Sir,—In the *Astronomical Register*, for Nov. 1869, Mr. F. Bird called attention to a new triple in Draco, near the planetary Nebula, 37 H IV., and gave its approximate position. I have recently looked it up, and find its place for 1870 is as follows:—

Argelander (+67°) No. 1039, mag. 9·1. R.A. 17h. 52m. 57s. Dec. + 67° 1′·2.

This is not included in any of the catalogues of double stars. Mr. Bird gives the magnitudes as 8·9=9, and 11·8. The two brighter are about 25″ apart, the smaller being at equal distances from them on the line joining the two. This precedes the nebula 5m. 40s., its declination being 22′·9 greater. It is a rather singular looking object from the position of the small star, and well worth recording.

S. W. BURNHAM.

Chicago: Sept. 16.

NEW MULTIPLE STAR IN CASSIOPEA.

Sir,—I beg to call the attention of double-star observers to a new multiple star in Cassiopea, one of the most beautiful objects of its kind in the heavens. Its catalogue place for 1870 is as follows:—

Argelander (+55°) No. 191. Mag. 7·7. R.A., 0h. 45m. 12s. Dec. + 55° 55′

This was discovered as a triple, Sept. 12th, 1871, and noted in a letter in the *English Mechanic*, of Nov. 24th. While looking for another object, Sept. 14th, 1872, I picked it up, and saw at once that the brightest star of the triple was a close double, and that there was a very minute star to the north of the primary not before noticed. As a triple it is quite an easy object, and singularly overlooked by former observers. Having observed the close companion but once, I am not able to speak very positively of its difficulty. On this occasion I saw it very readily with my 6-in. refractor, and was surprised at having missed it before. I can only account for it by supposing the atmosphere at that time was unsteady, or only moderately good. The last observation, however, was made under very favourable circumstance. Among other doubles found and afterwards identified, was the close pair of P. XX. 178 in Delphinus, discovered by Dawes, the distance of which is but 0″·5. This is a more difficult object than γ^2 Andromedæ. I compared the close pair of the triple with Dawes' close pair in P. XXIII. 101, Cassiopea, and found the distance was about the same, and with no great difference in difficulty, Dawes' being, perhaps, a little the easiest. He gives the distance as 1″·5.

The estimated distances, positions, and magnitudes, are as follows:—

A and B.	P=90°·	D=1″·5	M=7¾ 11
A and C.	135·	4·	8½
A and D.	200·	10·	10
A and E.	360·	15·	15

As will be seen the companions are somewhat curiously arranged around the principal star, the angles increasing with the distances. With the single exception of the trapezium of Orion, I do not know of a more elegant object. The stars B and E are the most accurately found. There are two small stars preceding the group, as well as others more distant in the same field. For the benefit of those not provided with an

equatorial mounting, I may add that to find this object it is only necessary to place the instrument upon α Cassiopea, and wait 12m. 4s., and this star will be found in the field, the declination of the two differing but 5′ 43″. S. W. BURNHAM.

Chicago, Sept. 16th.

PROFESSOR P. SMYTH ON THE HARVEST MOON.

Sir,—Having just received from some one unknown, a copy of your issue of October 15, I find my attention called therein to a letter signed "Sabreur," demanding either a criticism of a certain Dr. Duncan's description of the harvest moon, or a new account thereof.

Now the harvest moon has been so abundantly explained and commented on in dozens of popular astronomy books during the last hundred years, that any man who can read has only to go to a library and find all the facts of the case in print, both ready to his hand and meet for the instruction of his mind. But knowledge for science's sake alone is unhappily far from the thoughts of "Sabreur," whose letter too surely betrays something else first—*i.e.*, that the unfortunate Dr. Duncan having ventured to come, with some innocent enough and not very new notions on final causes, between the wind and "Sabreur's" decidedly rationalistic nobility, "Sabreur" immediately mounts the high horse of the daily press, and, flourishing his ugly weapon of murder over his head, invokes all and sundry of the present age, but specially practical astronomers, to join with him in cutting and hacking at, in slashing, plunging, and slaying a poor solitary wretch who has been caught in the very fact of writing, and under his own proper name, the thing which is odious to modern infidelity.

And what have I, as a practical astronomer so called upon, got to say in the matter? Why, this:

(1.) Excepting some verbal inaccuracies, Dr. Duncan gives a fair account of the well-known fact that when any full moon occurs on or near the 21st of September the three or four nights immediately following have in our latitudes earlier and longer continued moonshine than the similar nights following any other full moon throughout the year—the phenomenon varying slightly from year to year, but being substantially as above.

(2.) If the farmers, as avouched by Dr. Duncan, have not only perceived that fact under the name of the harvest moon, but are also thankful to God for the use they are enabled to make of it, they do well, though they might do more. They might, for instance, join with astronomers who see in the celestial mechanics producing the harvest moon phenomenon a happy appendix or corollary to those grander arrangements which have both given rotation to the axis of the earth, and placed that axis at a large angle to the plane of the earth's orbit round the sun—arrangements without which the alternations of day and night, and summer and winter, so necessary to the life and labours of man, could not be. And when these arrangements are also found to be so nicely bound up with others more special still, deciding the size of the earth's orbit, its distance from, and degree of heating by, the sun as best adapted to any abode appointed for man—together with the external and internal constitution of our globe, not merely as to air and water for animal life, but also as to the wondrous chemical elements from which man now draws so abundantly the means of material power and exalted usefulness—why, then, the devout astronomer not only treads in the steps of the farmer, so far as he goes, but further still—prays thankfully and with all the positive instruction of revelation, to God the Father, the Son, and the Holy Ghost, of whom, if in mere chronological

sequence, it can hardly be said that He created all these things *for man*, yet He created man so suitably *for them*, and with such wonderful wisdom foreseeing every detail, that we need no longer be in any difficulty at the inspired statement, that no hair of our head can fall unheeded by Him, and no passing word be uttered by us unnoted above and unregistered for future account!

Wherefore the sooner this vindictive "Sabreur" turns his bloodthirsty and would-be destroying blade into a peaceful pruning-hook, and strives in purity of heart and openness of name to cultivate friendly relations with those who are enabled to see God in small things, as well as great, the better for him both here and hereafter.

C. PIAZZI SMYTH,
Astronomer Royal for Scotland.

Royal Observatory,
Edinburgh: October 19, 1872.

—*Dundee Advertiser.*

SUN.

Greenwich, Noon. 1872.		Heliographical western longitude of the centre of the sun's disc.		Heliographical latitude of the centre of the sun's disc.		Angle of position of the sun's axis.	
		°	°	°		°	
Dec. 1	...	7·30	13·19	+0·54	—·13	15·80	—·39
2	...	20·49	13·19	0·41	·12	15·41	·41
3	...	33·68	13·20	0·29	·13	15·00	·41
4	...	46·88	13·19	0·16	·13	14·59	·41
5	...	60·07	13 19	+0·03	·13	14·18	·42
6	...	73·26	13·19	—0·10	·13	13·76	·42
7	...	86·45	13·20	0·23	·13	13 34	·43
—							
8	...	99·65	13·19	—0·36	—·12	12·91	—·43
9	...	112·84	13·19	0·48	·13	12·48	·44
10	...	126·03	13·19	0·61	·13	12·04	·44
11	...	139·22	13·19	0·74	·13	11·60	·45
12	...	152·51	13·19	0·87	·12	11·15	·45
13	...	165·80	13·19	0·99	·13	10·70	·46
14	...	178·89	13·19	1·12	·13	10·24	·46
—							
15	...	191·98	13·19	—1·25	—·12	9·78	—·46
16	...	205·17	13·19	1·37	·13	9·32	·46
17	...	218·36	13·19	1·50	·13	8·86	·47
18	...	231·55	13·19	1·63	·12	8·39	·47
19	...	244·74	13·19	1·75	·12	7·92	·47
20	...	267·93	13·19	1·87	·13	7·45	·48
21	...	271·12	13·18	2·00	·12	6·97	·48
—							
22	...	284·30	13·19	—2·12	—·12	6·49	—·48
23	...	297·49	13·19	2 24	·13	6·01	·48
24	...	310·68	13·19	2·37	·12	5·53	·49
25	...	323·87	13·18	2·49	·12	5·04	·48
26	...	337·05	13·19	2·61	·12	4·56	·49
27	...	350·24	13·18	2·73	·12	4·07	·49
28	...	3·42	13·19	2·85	·12	3·58	·49
—							
29	...	16·61	13·19	—2·97	—·11	3·09	—·48
30	...	29·80	13·18	3·08	·12	2·61	·49
31	...	42·98		3·20		2·12	

Assumed daily rate of rotation, 14°·20.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN DEC., 1872.

By W. R. Birt, F.R.A.S., F.M.S.

On September 17, 1871, the value of supplement ☾ — ☉ was 138° 15′·1 (see vol. ix., p. 217.) On November 15, 1871, the value was 134° 24′·9 (see vol. ix., p. 270.) On December 3, 1872, the value is 136° 30′·4. The lists for September and November, 1871, may therefore be consulted for objects suitable for observation in December, 1872.

Twelfth Zone of objects from North to South, 20° to 25° W. long.

Meton (the west part), Mrs. Somerville (*a*), Posidonius γ (*b*), Plinius,* Ross,* Manners (*c*), Sabine, Hypatia, Cyrillus, Catharina, Polybius, Pons,* Zagut,* Lindenau,* Rabbi, Levi,* Büsching, Schomberger (the east part).

Objects marked thus (*) have not been mentioned in the monthly lists.

(*a*) A conspicuous crater N.W. of Aristoteles marked B by Beer and Mädler. It was named by the late Dr. Lee to commemorate the scientific works of Mrs. Somerville.

(*b*) This mountain is interesting on account of its presenting similar phenomena to Linné, and especially so as the two objects are exceedingly different the one from the other. In both a small orifice can be detected with large apertures, and as the sun rises high upon them they are at the present epoch surrounded and covered by a white spot exceeding them in size. In connection with these white spots attention may be called to a large white spot, west of Picard, in the Mare Crisium, which was constantly observed between 1859 and 1863 or later, but has recently not been seen of its former extent It is now much smaller.

(*c*) A conspicuous crater between Arago and Ritter marked A by B and M. It has been named Manners in commemoration of a late president of the Royal Astronomical Society.

As portions of Zones 11 and 12 pass through the Mare Serenitatis, it would be well to observe and compare them with the monogram, especially as they contain objects suspected of having undergone change. The Zones may be advantageously examined between five and seven days of the moon's age.

Season.—Autumn in the northern hemisphere. North pole in darkness. The sun crossed the moon's equators on Nov. 24. Objects in high northern latitudes may be well studied on the 5th, 6th, and 7th.

In the list for October attention was called to the fact that the further prosecution of observation of variation of tint on the moon's surface was left entirely in private hands, and the region S.S.E. of the Mare Serenitatis was pointed out as a very suitable one for observations of the same kind as those of Plato. During the months of August, September, and October, as many as seventeen separate objects have been brought under observation, embracing an extent of tint varying from 0·24 to 0·70 of the Plato scale, or that employed in the discussion of the Plato observations which, from a careful comparison, with the tints of the general scale deduced from those used by Schröter, Zohrmann, and Bandell, is equal to a range of 3°.75 on the general scale, the zero of which is black shadow and the upper limit 10° which represents the brightest object on the moon's surface—the central mountain of Aristarchus. In the observations August to October the darkest observed tint of Plato was 0·70, or a little darker than 1°·25 of the general scale. The lightest was 0·40 or nearly 3°·75 of the general scale. During the three months Zohrmann's Boscovich varied to the extent of 0·06 only, or 0°·5 of the general scale, Darkest 0·66 = 1·5, lightest 0·60 = 2°·0 the variation of Plato during the same period was 2°·5.

Plato Scale	0·66	0·60	0·54	0·48	0·42	0·36	0·30	0·24.
General Scale	1·5	2°·0	2°·5	3°·0	3°·5	4°·0	4°·5	5°·0.

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
Sun	1	 9 58 19 43	Sidereal Time at Mean Noon, 16h. 42m. 35·82s. Conjunction of Mars and η Virginis (3·1m) Conjunction of Moon and Mercury 0° 35′ N.	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	14 34 15 48 16 54 18 8	Alde-baran. — 11 44·1
Mon	2	21 3	Conjunction of Moon and Venus, 1° 41′ N. Saturn's Ring: Major Axis = 34″·82 Minor Axis = 14″·08	1st Ec. D. 2nd Oc. R. 1st Oc. R.	11 53 50 13 25 15 25	11 40·2
Tues	3	0 4	Conjunction of Moon and Saturn 3° 47′ N. Sun's Meridian Passage, 9m. 47·91s. before Mean Noon	1st Sh. E. 1st Tr. E.	11 23 12 36	11 36·2
Wed	4	12 53	Conjunction of Saturn and Venus, 2° 0′ S.			11 32·3
Thur	5					11 28·4
Fri	6	23 36 8 3 9 9 9 24 10 14	☽ Moon's First Quarter Occultation of τ^1 Aquarii (6) Reappearance of ditto Occultation of τ^2 Aquarii (4) Reappearance of ditto			Moon. — 5 32·6
Sat	7			3rd Sh. E. 3rd Tr. I. 2nd Sh. I. 4th Ec. D. 3rd Tr. E. 2nd Tr. I. 2nd Sh. E. 1st Ec. D.	13 28 14 38 16 8 18 11 59 18 19 18 38 19 4 19 18 35	6 22·9
Sun	8			1st Sh. I. 1st Tr. I. 1st Sh. E.	16 28 17 40 18 48	7 10·4
Mon	9	3 22 4 26 7 16 8 9	Occultation of 35 Ceti (6½) Reappearance of ditto Occultation of *f* Piscium (5½) Reappearance of ditto	2nd Ec. D. 2nd Oc. R. 1st Oc. R.	13 46 50 15 57 17 16	7 56·6
Tues	10			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	10 56 12 8 13 16 14 28	8 42·5
Wed	11			2nd Tr. E. 1st Oc. R.	10 44 11 44	9 29·3
Thur	12	15 23	Near approach of B.A.C. 1242 (6)			10 17·7
Fri	13					11 7·9
Sat	14	9 44	○ Full Moon	3rd Sh. I. 3rd Sh. E. 3rd Tr. I. 2nd Sh. I.	13 42 17 25 18 24 18 42	11 59·7
Sun	15	22 55 19 4 20 20 21 9	Inferior conjunction of Mercury Conjunction of Moon and Uranus 4° 4′ S. Illuminated portion of disc of Venus = 0·780 Illuminated portion of disc of Mars = 0·913 Occultation of 37 Geminorum (6) Reappearance of ditto	1st Sh. I. 1st Tr. I.	18 21 19 30	12 52·0

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon.
Mon	16	18 45 19 14	Occultation of κ Geminorum (3½) Reappearance of ditto	4th Tr. I. 2nd Ec. D. 1st Ec. D. 4th Tr. E. 2nd Oc. R. 1st Oc. R.	13 28 13 13 49 15 39 51 17 15 18 26 19 6	— 13 43·8
Tues	17		Sidereal Time at Mean Noon, 17h. 45m. 40·76s.	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	12 49 13 58 15 19 16 18	Aldebaran. — 10 41·2
Wed	18		Sun's Meridian Passage, 2m. 55·32s. before Mean Noon	2nd Tr. I. 2nd Sh. E. 3rd Oc. R. 2nd Tr. E. 1st Oc. R.	10 17 10 53 12 5 13 10 13 33	10 37·3
Thur	19	22 37 13 34 14 51	Conjunction of Moon and Jupiter, 4° 31′ S. Occultation of η Leonis (3½) Reappearance of ditto	1st Sh. E. 1st Tr. E.	9 38 10 45	10 33·3
Fri	20					10 29·4
Sat	21			3rd Sh. I.	17 40	10 25·5
Sun	22	14 11	☽ Moon's Last Quarter Saturn's ring: Major axis=34″·31 Minor axis=13″·56			10 21·5
Mon	23	15 28	Conjunction of Moon and Mars, 2° 23′ S.	2nd Ec. D. 1st Ec. D.	15 49 55 17 32 53	10 17·6
Tues	24	20 54	Conjunction of Mars and θ Virginis 0·4m. S.	4th Ec. D. 1st Sh. I. 1st Tr. I. 4th Ec. R. 1st Sh. E. 1st Tr. E.	12 10 37 14 43 15 47 16 55 56 17 4 18 6	10 13·7
Wed	25	4 58	Conjunction of Mars and θ Virginis (0·6m.) W.	2nd Sh. I. 3rd Ec. R. 1st Ec. D. 3rd Oc. D. 2nd Tr. I. 2nd Sh. E. 1st Oc. R. 2nd Tr. E. 3rd Oc. R.	10 31 11 26 35 12 1 12 3 12 40 13 26 15 21 15 33 15 43	10 9·7
Thur	26	15 54 16 53 17 25 18 30	Occultation of 41 Libræ (6) Reappearance of ditto Occultation of κ Libræ (5) Reappearance of ditto	1st Tr. I. 1st Sh. E. 1st Tr. E.	10 14 11 32 12 33	10 5·8
Fri	27			1st Oc. D. 2nd Oc. R.	9 48 10 5	10 1·9
Sat	28	7 8	Conjunction of Moon and Mercury, 4° 5′ N.			9 57·9
Sun	29	18 36	● New Moon			9 54·0
Mon	30	14 31	Conjunction of Moon and Saturn, 3° 54′ N.	2nd Ec. D. 1st Ec. D.	18 26 7 19 25 58	9 50·1
Tues	31			1st Sh. I. 1st Tr. I. 1st Sh. E.	16 37 17 35 18 57	9 46·1

THE PLANETS FOR DECEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m
Mercury ...	1st	18 3 0	—25 26	7″·2	1 20·2
	15th	17 45 36 17 37 46	—21 43 —21 22½	9″·8	0 5·8 23 56·0
Venus ...	1st	19 4 29	—24 33½	13″·1	2 21·5
	15th	20 7 33	—24 18	14″·9	2 39·5
Mars ...	1st	12 17 17	— 0 15½	6″·2	19 31·5
	15th	12 45 33	— 2 59	6″·8	19 4·6
Jupiter ...	1st	10 14 0	+11 56	36″·3	17 28·5
	15th	10 15 26	+11 52	37″·7	16 34·9
Uranus ...	14th	8 31 45	+19 31	4″·2	7 54·9
Neptune ..	2nd	1 30 43	+ 7 36		8 42·8
	14th	1 3′ 4	+ 7 33		7 54·9

Mercury sets more than an hour after the sun at the beginning of the month, the interval decreasing after the 15th. On and after, he is a morning star rising at the end of the month nearly two hours after the sun.

Venus is well situated for observation for some time after the sun. sets, the interval increasing from 2h. at the beginning of the month to 3¾h. at the end.

Mars may be seen about 1½h. after midnight, the interval decreasing to an hour at the end of the month.

Jupiter is in a good position for observation, rising 2h. before midnight at the beginning of the month, the interval increasing to about 4h, on the 31st.

Uranus may be seen well throughout the night.

Neptune is well situated for observation.

MOON.

LIBRATION. SUN'S PLACE. Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* | *Sun's* centre in the zenith.

TERMINATOR. Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.

Greenwich midnight.

	colong.	lat.	colong.	lat.		60° N.	0°	60° S.
1872.	°	°	°	°	°	°	°	°
						SUNRISE.		
Dec. 6	86·21	+6·78	350·07	+12·16	—0·32	79·5	80·1	86·0
7	85·35	6·41	2·23	12·15	0·35	91·6	92·2	92·8

8	84·74	+5·68	14·38	12·15	—0·38	103·7	104·4	105·1
9	84·39	4·65	26·53	12·14	0·41	115·8	116·5	117·2
10	84·31	3·38	38·67	12·14	0·44	127·9	128·7	129·4
11	84·47	1·96	50·81	12·13	0·47	140·0	140·8	141·6
12	84·84	+0·46	62·94	12·13	0·50	152·1	152·9	153·8
13	85·52	—1·04	75·07	12 12	0·53	164·2	165·1	166·0
14	86·19	2·47	87·19	12·13	0·56	SUNSET.		
—								
15	87·10	—3·75	99·32	12·13	—0·59	10·3	9·3	8·3
16	88·16	4·85	111·45	12·13	0·62	22·5	21·5	20·4
17	89·34	5·73	123·58	12·14	0·65	34·7	33·6	32·5
18	90·59	6·35	135·72	12·14	0·68	46·9	45·7	44·6
19	91·88	6·69	147·86	11·14	0·70	59·1	57·9	56·7
20	93·16	6·74	160·00	12·15	0·73	71·2	70·0	68·8
21	94·36	6·51	172·15	12·16	0·75	83·4	82·2	80·9
—								
22	95·43	—5·99	184·31	12·16	—0·78	95·6	94·3	93·0
23	96·25	5·18	196·47	12·17	0·80	107·8	106·5	105·1
24	96·80	4·10	208·64	12·17	0·82	120·1	118·6	117·2
25	96·98	2·78	220·81	12·18	0·84	132·3	130·8	129·4
26	96·74	—1·27	232·99		—0·86	144·5	143·0	141·5

Colong. = 90° —λ.

The following table furnishes for a score of lunar spots, the co-longitudes of the sun's centre at the times of its passing the true horizon of the spots, or when its zenith distance is 90°.

	Sun's Selenogr. Latitudes :						
	—1°.50	—1°.00	—0°.50	0°.00	+0°.50	+1°.00	+1°.50
	Sun's Co-longitudes at Sun-rise:						
	°	°	°	°	°	°	°
Posidonius A	331·80	331·49	331·18	330·88	330·57	330·26	329·95
Theophilus	333·39	333·49	333·60	333·70	333·80	333·90	334·00
Plinius... ...	347·02	346·88	346·75	346·61	346·47	346·34	346·20
Maurolycus	344·90	345·38	345.85	346·32	346·79	347·26	347·74
Linné	349.25	348·99	348·72	348·46	348·19	347·93	347·67
Manilius ...	351·60	351·48	351·35	351·22	351·09	350·96	350·83
Aristillus ...	359·98	359·66	359·32	358·99	358 65	358·32	357·99
Mösting A ...	5.14	5·17	5·20	5·22	5.25	5·28	5·31
Pico	10·73	10 23	9 72	9·21	8·70	8·19	7·68
Eratosthenes .	11 83	11·70	11·57	11·44	11·31	11·18	11·05
Tycho	10·48	10·95	11·41	11·87	12·34	12·80	13.27
Timocharis .	13·75	13·50	13 25	13·00	12·74	12·49	12·24
Clavius C .	12·34	13·12	13·90	14 67	15·45	16·23	17·01
Copernicus .	20·18	20·09	20·01	19·93	19·85	19·77	19·68
Laplace A .	27·97	27·50	27.03	26.56	26·09	25.62	25·15
Ramsden .	30·75	31·06	31·38	31 70	32 02	32·33	32·65
Heraclides ...	35·33	34·90	31.46	34·02	33.59	33·15	32·71
Kepler	37·91	37·84	37·77	37·71	37·64	37·57	37·50
Gassendi A ...	39·07	39.22	39·38	39 53	39·68	39·83	39·98
Aristarch ...	47·85	47·63	47·42	47.20	46·99	46·77	46·56
	At Sunset :						
Posidonius A	149·95	150·26	150·57	150·88	151·18	151·49	151·80
Theophilus	154·00	153·90	153·80	153·70	153·60	153·49	153·39
Plinius ...	166·20	166·34	166·47	166·61	166·75	166 88	167·02
Maurolycus	167·74	167·26	166·79	166·32	165·85	165·38	164·90

Linné... ...	167·67	167·93	168·19	168·46	168·72	168·99	169·25
Manilius ...	170·83	170·96	171·09	171·22	171·35	171·48	171·60
Aristillus ...	177·99	178·32	178·65	178·99	179·32	179·66	179·98
Mösting A ..	185·31	185·28	185·25	185·22	185·20	185·17	185·14
Pico	187·68	187·19	188·70	189·21	189·72	190·23	190·73
Eratosthenes.	191·05	191·18	191·31	191·44	191·57	191·70	191·83
Tycho... ...	193·27	192·80	192·34	191·87	191·41	190·95	190·48
Timocharis...	192·24	192·49	192·74	193·00	193·25	193·50	193·75
Clavius C ...	197·01	196·23	195·45	194·67	193·90	193·12	192·34
Copernicus ...	199·68	199·77	199·85	199·93	200·01	200·09	200·18
Laplace A ...	205·15	205·62	206·09	206·56	207·03	207·50	207·97
Ramsden ...	212·65	212·33	212·02	211·70	211·38	211·06	210·75
Heraclides ...	212·71	213·15	213·59	214.02	214.46	214·90	215·33
Kepler ...	217·50	217·57	217·64	217·71	217·77	217·84	217·91
Gassendi A .	219·98	219·83	219·68	219·53	219·38	219·22	219·07
Aristarch ...	226·56	226·77	226·99	227·20	227·42	227·63	227·85

To find the time of the Sun's centre passing the true horizon of Linnè on December 6, the sun's selen-latitude being 0°.32, the corresponding co-longitude is found, by interpolation between the 3d and 4th values in the line for Linnè, to be 348·63. According to the monthly list, sun's centre is in this co-longitude on December 6, about 10m. past 9h. But how much sooner or later becomes Linnè visible to us ?

At Tacherent in the most recent Russian territorial acquisition in Central Asia, the government is about to erect an astronomical observatory, to which will be added an establishment for magnetic and meteorological observations. The buildings are to be commenced immediately.—*Standard.*

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We are obliged to postpone Professor Donati's Address and other interesting matter for want of space.

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